

NUCLEAR SCIENCE ABSTRACTS

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BIOLOGY AND MEDICINE

3638

Atomic Energy Project, Univ. of Calif., Los Angeles
A NEW AUTOMATIC SHARPENER FOR MICROTOME
BLADES. Francis W. Bishop. May 1, 1954. 13p. Con-
tract AT-04-1-GEN-12. (UCLA-290)

A new compact microtome knife sharpener is described
which provides a semi-manual method of sharpening blades
for standard and ultra-thin sectioning. (auth)

RADIATION EFFECTS

3639

Los Alamos Scientific Lab.
THE RELATIVE BIOLOGICAL EFFECTIVENESS OF
TRITIUM BETA RAYS IN PRODUCING SPLENIC AND
THYMIC WEIGHT LOSS IN MICE. F. C. V. Worman, Donna
F. Turney, and Virginia Lotz. Jan. 1954. 13p. Contract
W-7405-ENG-36. (LA-1641)

One hundred and fifty female CF-1 mice were exposed to
total-body radiation by intraperitoneal injection of varying
doses of tritium oxide followed by addition of tritium oxide
to the drinking water to maintain approximately the desired
level in the body water over an exposure period of 120 hours.
One hundred and fifty mice were exposed over the same
period of time to varying doses of radium gamma radiation.
At the conclusion of the exposures the percentages of splenic
and thymic weight loss (based on control weights) were cal-
culated and compared as a function of dose. The beta radia-
tion from tritium was found to be approximately 1.3 times
as effective as the gamma radiation in producing splenic
atrophy and approximately 1.5 times as effective in produc-
ing thymic atrophy. Assuming equivalence of r, rem, and
rep of radium gamma rays the average RBE of tritium
beta radiation was 1.4 for the biological test systems used.
(auth)

3640

Los Alamos Scientific Lab.
STUDIES OF THE EFFECTS OF MASSIVE, RAPID DOSES
OF GAMMA RAYS ON MAMMALS. Wright H. Langham,
Samuel M. Rothermel, Kent T. Woodward, Clarence C.
Lushbaugh, John B. Storer, and Payne S. Harris. Nov. 1953.
60p. Contract W-7405-Eng-36. (LA-1643)

Results are reported from detailed studies of the radia-
tion syndrome occurring in mice and rats following exposure
to various massive doses of γ radiation. Data are presented
on pathological changes observed in tissue sections, effects
on the central nervous system, hematological changes, and
biochemical changes following various doses of radiation.
Data are included on dose rate effect on splenic and thymic
weight loss of mice and median survival time of monkeys,
and the effect of cysteine on median survival time of rats.
(C.H.)

3641

USING Co^{60} AND FISSION PRODUCTS IN PORK
IRRADIATION EXPERIMENTS. H. J. Gomberg, S. E.

Gould, J. V. Nehemias, and L. E. Brownell (Univ. of
Michigan, Ann Arbor). Nucleonics 12, No. 5, 38-42(1954)
May.

Gamma radiation from a 10-kilocurie Co^{60} source and
from spent fuel slugs was used to study the feasibility of
controlling trichinosis by irradiation of pork. The
irradiation of hog carcasses in a routine manner was
found to be feasible. Techniques and dosimetry used in
the tests are described. (C.H.)

3642

HOW BIOLOGICAL EFFECTIVENESS VARIES WITH X-
RAY ENERGY. Walter S. Moos (Univ. of Illinois,
Chicago). Nucleonics 12, No. 5, 46-9(1954) May.

Studies indicating a difference in radiation effects
with variation of x-ray energy are reviewed. Data are
presented on the biological effectiveness of x radiation of
various voltages on the survival of bacteria. It is con-
cluded that biological effectiveness is dependent on x-ray
wavelength and is affected by transition effect, absorption,
and specific ionization. (C. H.)

3643

THE DIAGNOSTIC VALUE OF THE IMMEDIATE PERIPH-
ERAL LEUKOCYTE RESPONSE FOR THE RAT TO WHOLE
BODY ROENTGEN IRRADIATION. J. Gershon-Cohen and
M. B. Hermel (Albert Einstein Medical Center, Philadelphia,
Penna.). Am. J. Roentgenol. Radium Therapy, Nuclear Med.
71, 846-52(1954) May

To test whether characteristic periodic and quantitative
changes in the whole and differential white blood cell counts
might occur with different doses of whole-body x irradiation
during the first twenty-four hour period after exposure,
several groups of rats were studied with doses varying from
85 to 5,000 r. It was found that: initial progressive
lymphopenia occurs during the first four hours after ex-
posure; the larger the dose, the more precipitous is the
initial drop of the curve of lymphocyte counts, and the more
persistent are the low counts; lethal doses cause lymphocyte
counts below 500/mm³; with doses of irradiation in the mid-
lethal ranges, leukocytosis occurs almost simultaneously
with the lymphopenia during the first few hours after
irradiation. Marked differences occur, however, in the
differential blood curves between sublethal and superlethal
doses. In the groups receiving superlethal doses, the early
marked leukocytosis succeeded by the marked combined
leukopenia and lymphopenia a few hours before death are
striking differences from the patterns of the white blood cell
curves in those groups receiving lethal or sublethal doses of
radiation. These differences may have significant diagnostic
and therapeutic value. (auth)

3644

IRRADIATION OF T-1 BACTERIOPHAGE WITH LOW
VOLTAGE ELECTRONS. Marguerite Davis (Yale Univ.,
New Haven, Conn.). Arch. Biochem. and Biophys. 49,
417-23(1954) Apr.

Data are presented on the bombardment of T-1
bacteriophage with low-energy electrons which
corroborate the evidence for the existence of an
internal morphology of the virus. The highly sensitive

genic material is located in the head of the virus, surrounded by a protecting protein coat of about 100 A thick. The tail of the virus is apparently inert except for possibly functioning as a mechanism of attachment for the virus to the host. Inactivation of the bacteriophage can be achieved by destroying a single unit on the virus surface of molecular weight of about 50,000. It is comparable in size to many of the enzymes and can perhaps be identified with the mechanism of attachment. (auth)

3645

CHANGES IN LENS DURING THE FORMATION OF X-RAY CATARACT IN RABBITS. Ruth van Heyningen, Antoinette Pirie, and J. W. Boag (Univ. of Oxford) and (Hammersmith Hospital, London, England). *Biochem. J. (London)* 56, 372-9(1954) Mar.

Glyceraldehyde phosphate dehydrogenase, glyoxalase, acetaldehyde oxidase, and aldolase are present in the rabbit lens. The activities of glyoxalase, and acetaldehyde oxidase fall during development of opacity in the lens after x-irradiation. The activity of aldolase is unchanged except in the opaque lens, when it is diminished. The content of coenzyme A and of the nicotinic acid falls gradually during the development of opacity. The weight of the irradiated lens is less than that of the fellow-eye during the early stage of opacity formation. These results are discussed in relation to the known changes in glutathione and in protein sulphhydryl groups in cataract. (auth)

3646

STUDIES ON CELL DIVISION. II. X-RADIATION AS A DIVISION INHIBITING AGENT. Edward Spoerl, L. E. Loveless, T. H. Weisman, and R. J. Balske (Mound Lab., Miamisburg, Ohio). *J. Bacteriol.* 67, 394-401(1954) Apr.

Measurements of the effects of continuous and short-term x radiation upon the division, growth, and viability of yeast and *E. coli* cultures show that cell division is inhibited selectively with either method of irradiation and that, in addition, a small inhibition of yeast growth occurs simultaneously with the inhibition of yeast cell division. The inhibition of yeast cell division was observed to include two aspects of division, an inhibition of budding and an inhibition of the cell separation process. (auth)

3647

ENERGY REQUIREMENTS FOR THE INACTIVATION OF BOVINE SERUM ALBUMIN BY RADIATION. Franklin Hutchinson (Yale Univ., New Haven, Conn.) *Radiation Research* 1, 43-52(1954) Feb.

The inactivation of monomolecular layers of bovine serum albumin with beams of very-low-voltage electrons demonstrates that there are at least two processes taking place in the inactivation of biological material with ionizing radiation. One process can be caused by electrons having only about 2.2 ev of energy and is tentatively identified with the inactivation process initiated by ultraviolet radiation. The other process is caused only by electrons having more than about 10-12 ev of energy and is probably the ionization of a molecule. The ratio of the probabilities of the two processes is of the order of 30:1, with the process identified with ionization being the more likely. This ratio is, within very broad limits, about what might have been expected from known probabilities of protein inactivation by ionization and by ultraviolet photon absorption. In the practical case of irradiation of biological material with ionizing radiation, the high-energy process involving ionization will predominate, justifying the common method of specifying doses of high-energy radiation in terms of ionizations or roentgens. From a comparison of the data above or below 10 volts, it may be inferred that the

presence in the molecule of "free" electrons ejected during ionization is not the major process in the inactivation of proteins by ionizing radiation. (auth)

3648

SOME OBSERVATIONS ON THE EFFECT OF GAMMA IRRADIATION ON THE BIOCHEMISTRY OF REGENERATING RAT LIVER. John F. Thompson, Magdalene S. Carttar and Wallace W. Tourtellotte (Univ. of Chicago, Ill.). *Radiation Research* 1, 165-75(1954) Apr.

The only consistent biochemical effects of gamma radiation (800 r) found in regenerating rat liver were a diminution in concentration and turnover of deoxyribonucleic acid phosphorus. The increased rate of incorporation of P^{32} into cytoplasmic ribonucleic acid in regenerating rat liver was contributed to by all of the subcellular cytoplasmic elements, and approximately to the same extent by each. (auth)

3649

SOME CHARACTERISTICS OF BIOLOGICAL DAMAGE INDUCED BY IONIZING RADIATIONS. L. H. Gray (Mount Vernon Hospital, Northwood, Middlesex, England). *Radiation Research* 1, 189-213(1954) Apr.

Mechanisms of biological damage induced by ionizing radiations are reviewed. Features of radiation damage which may be considered characteristic of the agent producing them, and early methods of detecting the damage are discussed. (C.H.)

3650

THE RELATIVE BIOLOGICAL EFFECTIVENESS OF RADIATION FROM A NUCLEAR DETONATION ON TRADESCANTIA CHROMOSOMES. Alan D. Conger (Oak Ridge National Lab., Tennessee). *Science* 119, 36-42(1954) Jan. 1.

Comparative data are presented on the relative biological effectiveness of radiation from a nuclear detonation and γ and fast neutron irradiation administered in the laboratory in production of chromatid aberrations in *Tradescantia*. (C.H.)

3651

AN INTERESTING PHENOMENON ASSOCIATED WITH IRRADIATION OF DRY MAIZE SEEDS. Drew Schwartz (Oak Ridge National Lab., Tennessee). *Science* 119, 45-6(1954) Jan. 1.

Observations are reported on maize plants grown from seed exposed to neutron radiation from a nuclear detonation. Data are compared with similar experiments in which seed were exposed to γ radiation from a Co^{60} source. Data are presented graphically on the relationship between seedling height and radiation dose. Apparent growth following exposure to high doses of radiation was due to cell elongation and the maximum height of the seedlings was reached in about 5 days. (C.H.)

3652

THE PRODUCTION OF DOMINANT LETHALS IN DROSOPHILA BY FAST NEUTRONS FROM CYCLOTRON IRRADIATION AND NUCLEAR DETONATIONS. William K. Baker and Elizabeth Von Halle (Oak Ridge National Lab., Tennessee). *Science* 119, 46-9(1954) Jan. 1.

Data are presented on the relative biological effectiveness of fast neutrons from cyclotron irradiation and from nuclear detonations as determined by means of induction of dominant lethals in *Drosophila*. It is concluded that the frequency of dominant lethals may be useful as a rather rapid, but crude, biological measurement of fast neutron dosage at high levels. Findings are compared with similar data on *Tradescantia*. (C.H.)

- 3653
X-RAY BREAKAGE OF LILY CHROMOSOMES AT FIRST MEIOTIC METAPHASE. Helen V. Crouse (Goucher College, Baltimore, Md.). *Science* 119, 485-7(1954) Apr. 16.

Studies are reported which indicate that x radiation produces an effect on fully condensed meiotic lily chromosomes which is detectable at the first meiotic division in the form of bridges which are interpreted as being half-chromatid bridges. (C. H.)

RADIATION HAZARDS AND PROTECTION

- 3654
Isotopes Div., Advisory Field Service Branch, AEC
AIR CONTAMINATION AND RESPIRATORY PROTECTION IN RADIOISOTOPE WORK. G. W. Morgan and C. R. Buchanan. Jan. 19, 1953. 29p. (AECU-2821)

Air contamination associated with the use of radioactive isotopes in the laboratory is discussed. Positive control measures to prevent contamination are emphasized. The various forms of possible contamination and mechanisms influencing their stability in the air are discussed. Data are included on maximum permissible air contamination values, the pathway of inhaled contaminants once they enter the respiratory system, and the characteristic absorption, deposition, and pulmonary retention pattern of contaminants. The characteristics of various respiratory protective devices are discussed. (C.H.)

- 3655
School of Aviation Medicine
THE BIOLOGICAL AND MEDICAL ASPECTS OF IONIZING RADIATION. REPORT NO. 7. THE EFFECT OF ANESTHETIC AGENTS ON RATS FOLLOWING WHOLE BODY IRRADIATION. Kenneth H. Burdick. Feb. 1954. 9p. (AF-SAM-21-3501-0005-7)

The effect of anesthetic agents was observed in 375 rats, irradiated with 570 r and anesthetized at 1 to 3 hrs, 24 hrs and 7 days after irradiation. Five anesthetic agents were utilized: cyclopropane, ethylene, ether, nitrous oxide, and thiopental. Of these agents, nitrous oxide, or the anoxia accompanying its use, may possible have afforded some degrees of protection, but only in the group anesthetized 1 to 3 hrs following irradiation. Thiopental seemed to increase mortality significantly. This may have been partly due to the more prolonged anesthesia. The amount of thiopental required for anesthesia following irradiation, however, was definitely reduced. Comparing the effect on various groups according to the time of anesthesia following irradiation, it would seem that a critical change in response to anesthesia may occur immediately following irradiation and before the appearance of the clinical manifestations of the radiation syndrome. (auth)

- 3656
Army Medical Research Lab., Fort Knox
EFFECT OF PARTIAL SHIELDING BY GRIDS ON SURVIVAL OF X-IRRADIATED RATS. J. G. Kereiakes, W. H. Parr, J. B. Storer, and A. T. Krebs. Feb. 12, 1954. 12p. (AMRL-139)

Exposure of rats to equal volume dose of x radiation (200 kg roentgens) through grids having various diameter hole size but a constant open area to closed area ratio resulted in increasingly greater survival as the hole size was decreased. It is concluded that the increased survival found in rats exposed through grids probably results from repair initiated in the irradiated areas by adjacent normal tissue. The importance of these local effects in comparison to remote effects is discussed. (auth)

- 3657
Knolls Atomic Power Lab.
METHOD FOR EVALUATING RADIATION HAZARDS FROM

- A NUCLEAR INCIDENT. J. J. Fitzgerald, H. Hurwitz, Jr., and L. Tonks. Mar. 26, 1954. 53p. Contract W-31-198-Eng-52. (KAPL-1045)

A method to evaluate the radiation hazards from a nuclear incident is discussed in this report. Several new formulas for the determination of the integrated dose from external and internal radiation, and the fall-out of activity from the fission-products cloud are developed in the appendixes. (auth)

3658

Los Alamos Scientific Lab.

- A THEORETICAL CONSIDERATION OF THE HAZARDS ASSOCIATED WITH ACUTE EXPOSURE TO HIGH CONCENTRATIONS OF TRITIUM GAS. E. C. Anderson and Wright Langham. Feb. 1954. 12p. Contract W-7405-eng-36. (LA-1646)

Theoretical consideration of the hazards associated with acute exposure to high concentrations of T_2 gas indicates that a lethal radiation dose would result only from explosive oxidation of very rich T_2 -air mixtures. If the gas remained as T_2 , the dose rate to a 1- μ layer of the respiratory surfaces would be very high (thousands of rep/sec), but the effect of doses of this magnitude on a very thin layer of these surfaces is completely unknown. Other hazards considered are whole-body radiation from dissolved T_2 in body fluids, biological oxidation of T_2 and subsequent absorption of the tritium water produced, auto-oxidation of the T_2 by the tritium beta rays and absorption of the tritium water, and Bremsstrahlung radiation of tissue surfaces. The orders of magnitude of these hazards are a few tenths rep/sec of exposure. (auth)

3659

- PERMEABILITY OF EXCISED MOUSE, RAT, AND HUMAN SKIN TO GASEOUS TRITIUM. Chester W. DeLong, Roy C. Thompson, and Harry A. Kornberg (General Electric Co., Richland, Wash.) *Radiation Research* 1, 214-17(1954) Apr.

The percutaneous absorption of tritium gas was studied using excised skin from mice, rats, and man. In terms of μ c tritium absorbed/ $cm^2/min/\mu$ c tritium/ cm^3 atmospheres, absorption rates found were, for mice $(254 \pm 44) \times 10^{-6}$; for rats, $(207 \pm 26) \times 10^{-6}$; and for man, $(72 \pm 16) \times 10^{-6}$. Although there is considerable uncertainty as to the applicability of these figures to intact animals, the relative permeability of human, rat, and mouse skins should be useful in the extrapolation of animal data to humans. (auth)

RADIOTHERAPY

3660

- Oak Ridge Inst. of Nuclear Studies
QUARTERLY PROGRESS REPORT [FOR] OCTOBER 1-DECEMBER 31, 1953. 36p. Contract AT-40-1-Gen-33. (ORO-116)

Administrative and educational activities and clinical studies involving the use of radioisotopes are summarized. Two patients with metastatic malignant melanoma were treated with I^{131} . Autopsy studies on one patient and biopsy studies on the other failed to show therapeutically significant concentration of radioactivity in the tumors. Data are included from tracer studies of the tissue distribution of Lu and Y in animals. Construction is reported of a standard-man-liquid phantom for radiation dosage studies. Design is reported of a remote control pipetter, a container to insure uniform irradiation of small diameter Au wire, a magnetic manipulator for loading radioactive Co wire, and a device for measuring and cutting radioactive Au seed. (C.H.)

3661

A SIMPLE TECHNIQUE FOR THE ESTIMATION OF RADIOACTIVE COMPONENTS OF PLASMA AFTER THE ADMINISTRATION OF RADIOACTIVE IODIDE. F. Brown and H. Jackson (The Christie Hospital and Holt Radium Institute, Withington, Manchester, England). *Biochem. J.* (London) 56, 399-406(1954) Mar.

The use of silver phosphate treatment and methanol precipitation of plasma proteins is described for the rapid quantitative determination of the relative proportions of thyroxine and iodine in plasma following the administration of radioactive iodide. Methanol precipitation enables the proportion of radioactivity associated with the plasma proteins which is not associated with thyroxine to be measured with facility. The findings in three patients treated with radioactive iodide have been compared with the results of administering destructive doses of radioactive iodide to rats. In all instances the findings were corroborated by application of chromatography and radioautography. The results so far suggest that the metabolism of protein material from the thyroid gland, which appears in plasma after destructive doses of radiation, follows different pathways in man and rat. It is suggested that the construction of curves showing the variation in the relative amounts of these radioactive components of plasma in patients treated with radioactive iodide may prove of value in assessing the effects of treatment. Further light, too, may be thrown on the processes occurring in the thyroid gland and its pathological counterparts. (auth)

TRACER APPLICATIONS

3662

Atomic Energy Project, Univ. of Rochester
THE METABOLISM OF D-LYSINE- ϵ -C¹⁴. M. Rothstein, C. Bly, and L. Miller. Apr. 1, 1954. Contract W-7401-eng-49. (UR-324)

D-lysine- ϵ -C¹⁴ was fed to rats or injected intravenously. Measurement of the distribution of radioactivity after 6 hours revealed that almost all of the C¹⁴ was found in the urine and in the non-protein fraction of the tissues. Only insignificant amounts of C¹⁴ activity were detected in the plasma and tissue proteins, and in the expired carbon dioxide. Examination of the urine collected for 24 hr after feeding D-lysine yielded no evidence for the presence of D-pipecolic acid. (auth)

3663

Atomic Energy Project, Univ. of Rochester
THE SURFACE CHEMISTRY OF BONE. 8. ON THE MECHANISM OF IONIC EXCHANGE. J. H. Weikel, Jr., W. F. Neuman, and Isaac Feldman. Apr. 2, 1954. 27p. Contract W-7401-eng-49. (UR-326)

While ion-exchange is a process now widely recognized as the means by which many physiological ions and many non-physiological internal emitters become fixed in the skeletal mineral, no critical study of this process has ever been reported. An apparatus described by Schweitzer and Nehls was utilized to study the isoelectric exchange between buffer solutions and crystals of hydroxy apatite—the prototype mineral of bone. As expected, the reaction could be described by first order kinetics. While a detailed analysis was not possible, the data obtained suggest the rate limiting step (of surface exchange) to be the escape, or diffusion, of the surface ion to the surrounding water shell against a potential gradient. The participation of ions from the crystals' interior, or recrystallization, has been shown not to involve solution and redeposition. (auth)

CHEMISTRY

3664

Chemical Inspectorate, Ministry of Supply, London (England)
THE COMPLEXES OF OXIDISED NICKEL AND DIMETHYLGLYOXIME. PART 1. THE TETRA-DIMETHYLGLYOXIME, BIS-HYDROXY, NICKEL III, ANION. E. Booth, J. D. H. Strickland, and N. M. Waller. Apr. 1952. 17p. (CI/R-55; WAD/R-85)

In solutions of alkali hydroxides containing a suitable oxidant (e.g. hypobromite), divalent nickel reacts with dimethylglyoxime to give a red-brown solution. Photometric, ion exchange, and potentiometric studies have shown that this color arises from the presence of a trivalent nickel complex of the formula $[\text{Ni}(\text{OH})_2(\text{C}_4\text{H}_7\text{O}_2\text{N}_2)_4]^{1-}$, for which the most probable structure is suggested. (auth)

3665

Radiation Lab., Univ. of Calif., Berkeley
MERCAPTANS AND DISULFIDES: SOME PHYSICS, CHEMISTRY, AND SPECULATION. Melvin Calvin. Jan. 14, 1954. 43p. Contract W-7405-eng 48. (UCRL-2438)

A general review of the chemistry of the lower and intermediate oxidation levels of S is presented. Evidence is given for a cyclic (thiazoline) component in the structure of glutathione. The main problem discussed is the chemistry of the SH and SS systems such as might be involved in glutathione chemistry. (J.E.D.)

3666

Radiation Lab., Univ. of Calif., Berkeley
CHEMISTRY DIVISION QUARTERLY REPORT [FOR] SEPTEMBER, OCTOBER, NOVEMBER 1953. Jan. 11, 1954. 70p. Contract W-7405-eng-48. (URCL-2455)

Progress is reported on the following investigations: theory of α decay of spheroidal nuclei; an E1 transition in U²³⁸; half life and γ spectrum of Am²³⁸; conversion electron spectrum of Tl^{196m}; energy levels of Am²⁴⁰, Cm²⁴¹, and Np²⁴⁰; decay of Ir¹⁹² and Ag^{110m}; coincidence measurements of At²⁰⁸; α - γ coincidence studies of Fr²¹² and Rn²¹¹; γ radiation of Ac²²⁶, Ac²²⁸, and U²³⁶; bombardment of In with N ions; structure of the VO₂⁺ ion; solvent extraction behavior of the rare earths into TBP; crystal structure of AuCl₃; lattice parameters of Tb₂O₃, Dy₂O₃, Ho₂O₃, Er₂O₃, and Tm₂O₃; radiolysis products of diisopropyl ether and dibutyl ether; radical reactions in radiolysis; concentration of O₂ from air by selective transfer through Styrofoam; design of a source for mass spectroscopy; absorption spectrum of PuF₃; fission-product distribution of Ta; tentative identification of Rh¹⁰⁷ as the 2-hr, 16-min fraction from Ta fission; design of double retarding field electrostatic β -ray spectrometer; degradation of sedoheptulose; carboxylation reaction of photosynthesis; utilization of acetate-2-C¹⁴ by the livers of normal and pantothenic acid-deficient rats; effect of heparin on the metabolic oxidation of acetate-2-C¹⁴ in rabbits; effect of irradiation of mice on the concentration of coenzyme A and DPN-TPN in the liver; synthesis of labeled dipeptides; effect of ionizing radiation on choline and its analogs; studies on adenine metabolism; synthesis of radioactive thioctic acid; effect of β radiation on glycine; and hydrate complexing of Cr⁺³. (For preceding period see UCRL-2355.) (J.S.R.)

3667

Radiation Lab., Univ. of Calif., Berkeley
THE CHEMISTRY OF 1,2-DITHIOLANE (TRIMETHYLENE DISULFIDE) AS A MODEL FOR THE PRIMARY QUANTUM CONVERSION ACT IN PHOTOSYNTHESIS. J. A. Barltrop, P. M. Hayes, and M. Calvin. Mar. 1954. 79p. Contract W-7405-eng-48. (UCRL-2493)

Some chemical and photochemical observations of 1,2-dithiolane and its derivatives are reported with particular reference to the possible mode of function of the naturally occurring system, 6-thioctic acid. Experimental evidence is presented to demonstrate that the strain energy in this 5-membered ring is not less than 6.5 kcal and probably larger. Reagents which both oxidize and reduce this ring are described, together with the conditions required for its reformation from the corresponding dithiol. Evidence is adduced to indicate that the primary product of photolysis of this ring in acetic media is very likely a thiol and sulfenic acid or derivative thereof. (auth)

3668

FERRIC METAPHOSPHATE EXPERIMENTS. Olof Samuelson. Translated by Philip C. Osberg from *Iva 17*, 9-16(1946). 6p. (AEC-tr-1867)

A series of experiments were made to determine how much Fe^{+3} could be complexed in a solution of metaphosphate. The amount of Fe^{+3} was measured by ion exchange, absorption spectrophotometry, and analysis of the precipitates. (J.S.R.)

3669

EXPERIMENTS WITH COMPLEX SALT SOLUTIONS USING ORGANIC ION EXCHANGER. [PART] 3. Olof Samuelson. Translated by Philip C. Osberg from *Iva 17*, 17-22(1946). 4p. (AEC-tr-1872)

Organic ion exchangers were used to study the possible complexity of Zn, Ni, Co, and Cu with Cl^- solutions. No evidence of complex formation was found. (J.S.R.)

3670

THEORY OF THE LIMITING CURRENTS DURING REDUCTION OF HYDROGEN IONS IN SOLUTIONS OF WEAK ACIDS. S. G. Mayranovskii [Mayranovskiy] and M. B. Neyman. Translated from *Doklady Akad. Nauk S.S.S.R.* 82, 93-6(1952). 9p. (AEC-tr-1891)

The theory of limiting currents was applied to the analysis of hydrogen ion reduction waves of weak acids. The equation for the limiting current is derived. To confirm the equation, the behavior of oxalic, chloroacetic, hydrochloric, salicylic, acetic, benzoic, and phenylacetic acids were investigated with the Hg drop electrode. Experimental values of limiting current are in good agreement with the theoretical values, and the limiting current is not proportional to the acid concentration. (J.S.R.)

3671

THE INTERACTING SYSTEM CONSISTING OF HYDROXIDES AND CHLORIDES OF POTASSIUM AND LITHIUM. [G. M. Unzhakov]. Translated from *Doklady Akad. Nauk S.S.S.R.* 87, 791-3(1952). 7p. (AEC-tr-1892)

The binary systems $\text{KOH}-\text{LiOH}$, $\text{LiCl}-\text{KCl}$, $\text{LiOH}-\text{LiCl}$, and $\text{KOH}-\text{KCl}$ were investigated by the visual-polythermal method. The composition and fusion points of melts at invariant points are tabulated, and a phase diagram of the $\text{K,Li 11 OH}_2\text{Cl}$ systems is given. (J.S.R.)

3672

HYDROLYTIC BEHAVIOR OF METAL IONS. III. HYDROLYSIS OF THORIUM(IV). Kurt A. Kraus and Robert W. Holmberg (Oak Ridge National Lab., Tennessee). *J. Phys. Chem.* 58, 325-30(1954) Apr.

Hydrolysis of thorium(IV) in perchlorate and chloride solutions ($\mu \sim 1$) was studied potentiometrically with a glass-calomel electrode system as a function of thorium concentration (2.5×10^{-4} to $1.5 \times 10^{-3}\text{M}$) and acidity. The existence of the unhydrolyzed species Th^{+4} was confirmed. The hydrolytic reactions up to a hydroxyl number (average number of hydroxide ions per thorium) $n \sim 2$ were found to be readily reversible. The hydrolysis of thorium(IV) is concentration dependent, even in the early stages of hydrolysis. Even for $n < 0.5$ several hydrolysis products

must be postulated to explain the data. Of these, the species $\text{Th}(\text{OH})_2^{+2}$ and $\text{Th}_2(\text{OH})_2^{+6}$ seem to be definitely established, and estimates of their stability constants are given. The equilibrium constant for the reaction $\text{Th}^{+4} + 2\text{H}_2\text{O} \rightleftharpoons \text{ThOH}^{+3} + \text{H}_3\text{O}^{+}$ was found to be surprisingly small ($\sim 5 \times 10^{-5}$) compared with the constants for U^{+4} and Pu^{+4} ($\sim 3 \times 10^{-2}$) and could not be established with certainty. Other species including higher polymers probably are formed during the hydrolysis. The thoryl ion or a polymer of it ($(\text{Th}(\text{OH})_2)_N^{+2}$) does not show great stability. Hydrolytically, thorium(IV) appears to be sufficiently different from U(IV) and Pu(IV) to make it questionable if it should be included in the same rare-earth-like series (actinide or thoride). (auth)

ANALYTICAL PROCEDURES

3673

Atomic Energy Research Establishment, Harwell, Berks (England)
THE USE OF AN ANNULAR SAMPLE ASSAY UNIT, TYPE 1044B, FOR THE MEASUREMENT OF EQUILIBRIUM IN URANIUM ORES. R. K. Barnes. Jan. 18, 1950. 5p. (AERE-EL/M-76)

3674

Hanford Works
CHEMICAL ANALYSIS BY X-RAY PHOTOMETRY. M. C. Lambert. Jan. 25, 1954. 19p. Contract W-31-109-Eng-52. (HW-30634)

Application of x-ray photometry to the analysis of solutions containing both single and mixed solutes is discussed along with examples for calculating the magnitude of error due to interferences. Interchangeable glass cells with volumes as small as 0.5 ml are described, and a guide is given for determining the permissible concentration range for any element at different voltages and path lengths. Three variations of technique are described, including a differential technique by which it is possible to achieve a routine precision of 0.1 per cent. The factors involved in the precision of the method are discussed, and means of predicting the expected precision for a given determination are illustrated. The discussion is intended to help one evaluate the application of x-ray photometry to any problem of interest in the field of chemical analysis. (auth)

3675

North American Aviation, Inc.
URANIUM AND PERCHLORIC ACID IN COLORIMETRY. L. Silverman and L. Moudy. May 1, 1954. 22p. Contract AT-11-1-GEN-8. (NAA-SR-890)

In perchloric acid solution (2 to 65% by volume), at selected wavelengths, the colorimetric absorption of uranium solutions is proportional to the concentration. Uranium may therefore be determined colorimetrically as uranium perchlorate, under these conditions. Above 80 % perchloric acid (by volume) the absorption values deviate from Beer's Law, showing that a new species of uranium is present. Aluminum, iron, thorium, and zirconium perchlorate solutions do not absorb in the 415 to 420 m μ range. (auth)

3676

North American Aviation, Inc.
DETERMINATION OF OXYGEN IN CERTAIN GASES. L. Silverman and W. Bradshaw. Apr. 15, 1954. 35p. Contract AT-11-GEN-8. (NAA-SR-892)

Present day studies of corrosion of metals by liquids necessitate the preparation and analysis of inert gas blankets free, or nearly free, of oxygen. Micro amounts of oxygen may be determined in the inert gases, hydrogen, nitrogen, and carbon dioxide by a modification of the Winkler method, in which the oxygen is absorbed in manganous hydroxide; an equivalent amount of iodine is liberated, then extracted

into *o*-xylene and determined colorimetrically. The analysis takes place at low pressures, from 350 to 760 mm Hg, whereby a small volume of gas (250 to 500 milliliters) can be analyzed. A reproducibility of 0.7 parts per million or better was obtained over a range of 0 to 25 parts per million of oxygen (microliters per liter). The method can be extended to 150 parts per million of oxygen by extracting into larger quantities of *o*-xylene. Improved methods of removing dissolved oxygen from analytical reagents result in a constant, but low, blank which permits the degree of precision obtained. (auth.)

3677

Columbia Univ.

HYDROGEN-DEUTERIUM SEPARATION BY CHEMICAL EXCHANGE IN THERMAL DIFFUSION COLUMNS. Russell W. Pierce, William P. Senett, and T. I. Taylor. Sect. 2 of SEPARATION OF ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1, 1952 TO JULY 1, 1953. July 1, 1953. 13p. Contract AT(30-1)-755. (NYO-6239(Sect.2); CU-4-53-AT(30-1)-755-Chem.)

The design, construction, and calibration of a thermal conductivity bridge, a null-method one, for the analysis of H_2 - D_2 systems are described. (J.S.R.)

3678

Atomic Energy Project, Univ. of Rochester
INFRARED IDENTIFICATION IN PAPER CHROMATOGRAPHY. T. Toribara and V. DiStefano. Apr. 1, 1954. 13p. Contract W-7401-eng-49. (UR-325)

Chemicals present in spots on paper chromatograms can be identified by a combination of the potassium bromide pelleting technique and a silver chloride lens beam condensing system. To obtain sufficient quantities of trace constituents, larger samples can be handled by modifying the usual two-dimensional paper chromatographic method. The samples are freeze-dried to conserve material and eliminate the grinding operation which may itself lead to contamination. (auth)

3679

ACTIVATION ANALYSIS WITH NUCLEAR EMULSIONS. Giovanna Mayr (Universita degli Studi di Milano, Italy). *Nucleonics* 12, No. 5, 58-60(1954) May.

A method for activation analysis is described in which both sample and the nuclear emulsion are exposed together to the activating radiation. Half-life is eliminated as a limiting factor, and without producing a radioisotope an element can be evaluated by any nuclear reaction recorded in the emulsion. Applications discussed include a study of B metabolism, in which the highly ionizing α particles of the $B(n,\alpha)$ reaction were demonstrated with Kodak NTA emulsion, and a study of inactive I in the thyroid, in which the weakly ionizing β particles of the $I^{127}(n,\beta)I^{128}$ reaction were demonstrated with NTB emulsion. (C.H.)

3680

AUTOMATIC SPECTROPHOTOMETRIC TITRATIONS DETERMINATION OF MILLIGRAM QUANTITIES OF THORIUM. H. V. Malmstadt and E. C. Gohrbandt (Univ. of Illinois, Urbana). *Anal. Chem.* 26, 442-5(1954) Mar.

This investigation was undertaken to develop a spectrophotometric titration procedure in which a plot of absorbance vs. milliliters of titrant is automatically recorded and to apply the automatic spectrophotometric titration technique for the precise, accurate, and rapid determination of very small quantities of thorium. The Cary spectrophotometer was used to obtain the automatically recorded titration curves, and a new type of titration cell with quartz windows was designed and constructed; 1 to 50 mg. of thorium in 100 ml. of solution were determined with an accuracy within 1 part per thousand. The strong ultraviolet absorption band

of copper-Versenate was used to determine the end point. (auth)

3681

DETERMINATION OF SMALL AMOUNTS OF NIOBIUM IN PURE TANTALUM AND ITS OXIDE. Jane Hastings and Thomas A. McClarity (General Electric Co., Pittsfield, Mass.). *Anal. Chem.* 26, 683-5(1954) Apr.

A sensitive chemical method was needed for the analysis of pure tantalum metal. The spectrophotometric method for the determination of niobium by measuring the intensity of the ether extract of the yellow thiocyanate complex of niobium has been reported, but there has been no extension of the method to a material containing a preponderance of tantalum which reduces the intensity of the color. Details of concentration, manipulation, and timing must be strictly observed. A method is presented for the determination of niobium in pure tantalum metal in the range of 0.01 to 0.30% niobium with good reproducibility. No separations are necessary except for the extraction of the thiocyanate complex of niobium with ether. Contamination from large amounts of reagents is avoided. (auth)

3682

COLORIMETRIC DETERMINATION OF FLUORIDE. M. L. Nichols and A. C. Condo, Jr. (Cornell Univ., Ithaca, N. Y.). *Anal. Chem.* 26, 703-7(1954) Apr.

The bleaching effect of low concentrations of fluoride upon 18 organoferric colored complexes in acid solution was investigated to determine if any were sufficiently sensitive to be useful for the determination of fluoride. It was found that the iron(III) complexes of three reagents, resorcyldaloxime, 5-phenylsalicylic acid, and resacetophenone, gave approximately a 4% change in percentage transmittancy per 1 ppm of fluoride at a pH of 2 to 3 and the proper concentration of iron(III). However, the colored complex of resorcyldaloxime is not stable on standing for an appreciable period of time. The latter two complexes were found to be stable over long periods of time and to give reproducible and sensitive results for fluoride in concentrations from 0 to 6 ppm. Investigation of the effect of the presence of 13 foreign ions showed that those which form stable complexes with iron, such as citrate and tartrate, and also a high concentration of aluminum, interfere with the determination. (auth)

3683

DETERMINATION OF CARBON IN TANTALUM. A. F. Torrisi, Jean L. Kernahan, and R. E. Fryxell (General Electric Co., Pittsfield, Mass.). *Anal. Chem.* 26, 733-4(1954) Apr.

The low-pressure combustion method for the determination of C in steel has been adapted to determinations of C in Ta. The apparatus described by W. M. Murray and L. W. Niedrach (*Ind. Eng. Chem., Anal. Ed.* 16, 634(1944)) was used. A sample holder suitable for nonmagnetic samples is described. Reproducible results were obtained for temperatures from 800 to 1400°C, sample weights from 0.200 to 0.500 g, and combustion times from 5 to 20 min. Standard deviation for the C was usually about 0.0006%. The absolute accuracy of the low-pressure combustion method was probably within 0.0017% of C. (J.A.G.)

3684

BENZILIC ACID AS A REAGENT IN GRAVIMETRIC DETERMINATION OF ZIRCONIUM. Joseph J. Klingenberg, Peppino N. Vianes, and Melvin G. Mendel. (Xavier Univ., Cincinnati, Ohio). *Anal. Chem.* 26, 754-6(1954) Apr.

Benzilic acid can be used as a reagent for the gravimetric determination of zirconium and will precipitate zirconium quantitatively with increasing acidity if the quantity of benzilic acid used is also increased. The zirconium benzilate precipitate filters, washes, and ignites readily; and the

voluminous nature of the precipitate is advantageous in the detection and determination of small quantities of the element, although direct weighing is not possible. Benzoic acid also acts selectively in the presence of many of the foreign ions normally appearing with zirconium and can be utilized in the determination of zirconium in steel alloys. (auth)

3685

THE DETERMINATION OF POTASSIUM AND TRACES OF SODIUM IN SOME POTASSIUM SALTS. C. Jackson (Glaxo Lab., Limited, Ulverston, Lancashire, England). *Analyst* 78, 599-602(1953) Oct.

For determining sodium in certain potassium salts of weak acids the sample is titrated with 0.2N perchloric acid in glacial acetic acid, a small controlled excess being added. After the precipitated potassium perchlorate has been removed by filtration, the filtrate is evaporated to dryness and the sodium is determined as sodium zinc uranyl acetate. It is thus possible to estimate volumetrically the total equivalent alkali metal and gravimetrically both sodium and potassium on one sample. The method can be applied to the determination of sodium in most potassium salts. (auth)

3686

VACUUM-FUSION ANALYSIS OF MOLYBDENUM.

M. W. Mallett and C. B. Griffith (Battelle Memorial Inst., Columbus, Ohio). *Trans. Am. Soc. Metals* 46, 375-88(1954).

A vacuum-fusion apparatus was built which is capable of giving results reproducible to within ± 1 ppm by weight for both oxygen and nitrogen. The use of mercury cutoffs and all-glass diffusion pumps and furnace envelope reduces the volume of blank gases to 0.006 cc per hour at 1600°C. With the sensitivity of analysis provided by this apparatus, the effects of minute quantities of oxygen and nitrogen on the physical behavior of molybdenum may be determined. (auth)

ATOMIC WEIGHTS AND PERIODIC SYSTEMS

3687

ATOMIC MASSES IN THE INTERMEDIATE REGION. T. L. Collins, Walter H. Johnson, Jr., and Alfred O. Nier (Univ. of Minneapolis, Minn.). *Phys. Rev.* 94, 398-404 (1954) Apr. 15.

The double-focusing mass spectrometer previously described has been used to measure 28 atomic masses in the region between Ga and Nb. The new information combined with previous determinations permits a rather complete packing fraction curve to be drawn for the region from S through Xe. Analysis shows that masses for stable and unstable isotopes of an element can be fitted by parabolas, one for odd A and one for even A. The two parabolas have the same shape (except just above a proton shell) but are displaced in A as well as mass. The displacements are such that, for an isobar, the minimum mass does not occur at the same Z for the four nuclear families (even even, etc.), in contradiction to usual assumptions. (auth)

3688

THE LENGTH OF THE PERIODS IN THE PERIODIC SYSTEM. F. Tüdös (Univ. of Szeged, Hungary). *Naturwissenschaften* 41, 138(1954)Mar. (In English).

As the sequence of the filling up of orbitals is different from that derived from the quantum numbers, the length of the periods cannot be represented by the simple Pauli formula $L_n = 2n^2$, where n is the number of shells. The formula $L_n = 2(n^2 + 1)^2$ is suggested. (J.S.R.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

3689

Los Alamos Scientific Lab.

THE CRYSTAL STRUCTURE OF $[(CH_3)_4N]_2CeCl_6$. Don T. Cromer and Robert J. Kline. [1953?] 8p. Contract [W-7405-eng-36]. (AECU-2865)

$[(CH_3)_4N]_2CeCl_6$ has the R_2MX_6 fluorite-type structure with $a_0 = 13.05$ Å. It is isomorphous with the analogous tin and platinum compounds. Analysis of x-ray powder diffraction data leads to the value 2.55 Å for the Ce-Cl distance. (auth)

3690

POSITION CORRELATION OF THE EXTERNAL ELECTRONS IN SOME ACTINIDE LATTICES. K. Schubert (Max-Planck-Institut für Metallforschung, Stuttgart, Germany). *Naturwissenschaften* 41, 84-5(1954) Feb. (In German).

The position of the external electrons in the lattice structure of U, Th, Pa, and Np was discussed. (J.S.R.)

DEUTERIUM AND DEUTERIUM COMPOUNDS

3691

DETERMINATION OF THE ABSORBED WATER BY EXCHANGE WITH DEUTERIUM OXIDE. EXTENSION OF THE EXCHANGE METHOD TO THE STUDY OF MACROMOLECULAR STRUCTURES. (Determination, Par Echange Avec L'Oxyde De Deutérium, De L'eau Sorbée. Extension De La Methode D'échange A L'étude Des Structures Macromoléculaires). Rodolphe Viallard. Translated from *J. chim. phys.* 48, 372(1951). 2p. (AEC-tr-1887)

FLUORINE AND FLUORINE COMPOUNDS

3692

CONTINUOUS DISPOSAL OF FLUORINE. REACTION WITH SUPERHEATED STEAM. S. H. Smiley and C. R. Schmitt (Carbide and Carbon Chemicals Co., Oak Ridge, Tenn.). *Ind. Eng. Chem.* 46, 244-7(1954) Feb.

A pilot-plant investigation of a safe method for the continuous disposal of fluorine under widely variant conditions of concentration and flow rate outlines optimum operating conditions and materials of construction for the unit. The method is based on the reaction of fluorine with steam at moderately high temperatures. When preheated fluorine is mixed with superheated steam, an uninhibited burning occurs, releasing a large quantity of heat. The reaction is readily controlled by cooling the walls of the reactor. Using steam excesses between 200 and 1000% greater than stoichiometric requirements, a 500°F preheat temperature induces immediate reaction for fluorine concentrations greater than 50 mole %; at more dilute fluorine concentrations, a minimum preheat temperature of 750°F is necessary to ensure complete reaction. Violent explosive reactions between fluorine and water or low-temperature steam have been reported in the literature, and, consequently, the fluorine-steam reaction has been considered unreliable as a disposal method. When the fluorine and steam are preheated, however, the reaction can be controlled. (auth)

GRAPHITE

3693

THE (hklO) REFLEXIONS OF GRAPHITE. G. E. Bacon (Atomic Energy Research Establishment, Harwell, Berks, England). *Acta Cryst.* 7, 359-61(1954) Apr.

Some quantitative data are presented for the shape and position of the hklO reflections of graphite, in the intermediate region between a random-layer structure and a true three-dimensional structure. With increasing perfection the reflection rapidly becomes symmetrical, but the displacement of the peak decreases more slowly. (auth)

LABORATORIES AND EQUIPMENT

3694

Los Alamos Scientific Lab.

EVALUATION OF LABORATORY FUME HOODS. H. F. Schulte, E. C. Hyatt, H. S. Jordan, and R. N. Mitchell.

[1953] 20p. Contract [W-7405-eng-36]. (AECU-2859)

Design criteria for laboratory fume hoods are discussed and characteristics of some specific hoods are reviewed. A method of testing hood performance is described in which the flow pattern was determined of smoke from smoke candles and of smoke resulting from burning a mixture of sawdust and motor oil. (C.H.)

RADIATION CHEMISTRY

3695

MOLECULAR PRODUCT AND FREE RADICAL YIELDS OF IONIZING RADIATIONS IN AQUEOUS SOLUTIONS. Edwin J. Hart (Argonne National Lab., Lemont, Ill.). Radiation Research 1, 53-61(1954) Feb.

3696

A THEORETICAL SURVEY OF THE RADIATION CHEMISTRY OF WATER AND AQUEOUS SOLUTIONS. Harold A. Dewhurst, Aryeh H. Samuel, and John L. Magee (Univ. of Notre Dame, Indiana) Radiation Research 1, 62-84(1954) Feb.

3697

THE ROLE OF FREE RADICALS AND OXYGEN IN REACTIONS PRODUCED BY IONIZING RADIATIONS. E. S. Guzman Barron (Univ. of Chicago, Ill.). Radiation Research 1, 109-24(1954) Feb.

RADIATION EFFECTS

3698

Institute of Industrial Research, Syracuse Univ. NON-ELECTRONIC DOSE RATE INDICATING SYSTEMS. SEVENTH QUARTERLY PROGRESS REPORT [FOR] DECEMBER 15, 1953-MARCH 15, 1954. Herbert Rubin. 26p. Contract DA-36-039-SC-15533. (NP-5135)

This report describes the first steps in a systematic and quantitative study of some of the qualitative radiation effects on iron chlorides, pyridine, and mixtures of the two. To obtain accurate measurements of x-ray dosages, a ferrous sulfate actinometer and suitable associated irradiation equipment have been set up. Irradiations have been carried out on carefully purified, dried and degassed pyridine and carbon tetrachloride, and on mixtures of the two. Ferrous and ferric salts, $[\text{Fe}(\text{py})_4]\text{Cl}_2$ and FeCl_3 , dissolved in these solvents, have also been irradiated. The results of these experiments are discussed. (For preceding period see NP-5013.) (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

3699

THE SEPARATION AND PURIFICATION OF HOLMIUM BY PRECIPITATION OF THE HYDROXIDE. O. M. Hilal (Univ. of Alexandria, Egypt). Z. anorg. u. allgem. Chem. 275, 278-82(1954) Mar. (In German).

A satisfactory separation of Ho from Y was achieved by fractional precipitation of the hydroxide on introduction of an ammonia-saturated air stream; after 40 series of fractionation runs, an extensive enrichment of Ho was obtained. It is possible to carry out a fractionating decomposition of the nitrate, by which an effective enrichment of Y is found in the end fraction, whereas the Yb, which remains after the electrolytic reduction of the concentrate in the solution, is concentrated in the first fraction. The losses of Ho are low. The Ho-rich fraction was best separated by fractional precipitation with gaseous NH_3 , which prevented further loss. This method is also used for the separation of Yb from Er, which can not be done by the amalgamation method. (tr-auth)

3700

PRODUCTION OF RARE EARTH METALS IN QUANTITY ALLOWS TESTING OF PHYSICAL PROPERTIES. F. H.

Spedding and A. H. Daane (Iowa State Coll., Ames). J. Metals 6, 504-10(1954) May.

The metallothermic method for the production of La, Ce, Pr, and Nd from their chlorides was described. Y, Tb, Dy, Ho, Er, Tm, and Lu were prepared by the reduction of their fluorides with CaCl_2 in an open Ta crucible in a vacuum or an Ar atmosphere. Sm and Yb were prepared by distillation from their oxides in the presence of La. Eu was obtained in 1-g quantities by this method. Some of the physical properties of the rare earths are discussed. (J.S.R.)

3701

QUANTITATIVE SPECTROCHEMICAL DETERMINATION OF PRASEODYMIUM IN LANTHANUM AND EUROPIUM IN SAMARIUM IN A SPECTROGRAPH WITH AVERAGE DISPERSION ISP-22. G. Kryuger and R. R. Shvangiradze. Zhur. Anal. Khim. 9, 11-21(1954) Jan.-Feb. (In Russian)

A method is given for the spectrochemical determination of Pr in La (from 0.3 to 10%) and Eu in Sm (from 0.02 to 10%) by means of a commonly used spectrograph with average dispersion. The spectra were excited with an alternating arc, and Cu electrodes were used. CaSO_4 was added as a fixation agent. A mixture of the chief rare earth elements was used as internal standards. (J.S.R.)

SEPARATION PROCEDURES

3702

Columbia Univ.

THE FRACTIONATION OF LITHIUM ISOTOPES BY THERMAL DIFFUSION IN AQUEOUS SOLUTION (thesis). Gilbert Panson. Sect.6 of SEPARATION OF ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1, 1952 TO JULY 1, 1953. July 1, 1953. 34p. Contract AT(30-1)-755. (NYO-6239(Sect.6); CU-4-53-AT(30-1)-755-Chem.)

Thermal diffusion produces a fractionation of lithium isotopes in aqueous LiCl and LiNO_3 solutions of high concentration with the Li^7 concentrated at the bottom of the column. Fractionation occurs to approximately the same extent in 5M LiNO_3 and 5M LiCl . There were no marked differences of the extent of fractionation in 5 and 10M solutions. In 0.5M LiNO_3 no clear-cut separation was found. The magnitude of the observed enrichments (20%) could be satisfactorily accounted for by analogy to the case for the thermal diffusion of mixtures of H_2O and D_2O with a small correction for the effect of the ionic charges of the lithium ions. (auth)

3703

Chalk River Project (Canada)

CONTROL OF Sr^{90} PURIFICATION BY ADAPTATION OF SCHWARZENBACH METHOD FOR THE DETERMINATION OF ALKALINE EARTHS. L. W. Wray. Mar. 2, 1954. 15p. (PDB-109)

The application of the Schwarzenbach method for water hardness to the determination of the total alkaline earths in Sr^{90} feed solution has been investigated. This method involves a titration with (ethylenediamine)tetraacetic acid (versene). It is shown that the error in the method is less than one percent and can be used for the control of Sr^{90} purification by cation exchange. The complexing capacity of versene has been verified. (auth)

3704

HOLDUP AND APPROACH TO STEADY STATE. Donald F. Peppard (Argonne National Lab., Lemont, Ill.) and Marvita A. Peppard (715 Thomas, Oak Park, Ill.). Ind. Eng. Chem. 46, 34-9(1954) Jan.

Determination of the number of cycles required for a given approach to steady-state operation for a system with a large number of stages is an important problem in the investigation of liquid-liquid fractionation of rare earths,

since sharp fractionation by the techniques now under study requires the use of 20 to 30 stages. An equally important problem is that of holdup. Since the systems employed closely approximate the ideal double-diamond (odd number of stages, center feed), exact expressions are derived for the holdup and σ , the degree of departure from steady-state, for such idealized systems. These expressions are evaluated at various E 's for systems of different numbers of stages. Two approximate expressions for σ , much simpler to use than the exact one, have been derived and evaluated and found satisfactory for most purposes. By means of these expressions, both the number of cycles required for a given approach to steady-state operation and the holdup of the system may be calculated, thereby simplifying the design and interpretation of fractionation experiments. (auth)

3705

SEPARATION OF TANTALUM AND NIOBIUM BY LIQUID-LIQUID EXTRACTION. J. R. Werning, K. B. Higbie, J. T. Grace, B. F. Speece, and H. L. Gilbert (U. S. Bureau of Mines, Albany, Oreg.). *Ind. Eng. Chem.* **46**, 644-52(1954) Apr.

New methods for producing pure tantalum and niobium from ores and synthetic mixtures have been proposed periodically, but they have not proved satisfactory for more than a few specified conditions. The need for large amounts of high-purity tantalum and niobium has increased tremendously in recent years. The development of liquid-liquid extraction techniques for the separation of other metal systems has offered a new approach to this problem. Tantalum and niobium products of greater than 99% purity have been obtained when the feed mixture was contacted with methyl isobutyl ketone in a perforated-plate pulse column. The process involves the preferential extraction of tantalum by the ketone from hydrofluoric acid. A subsequent addition of hydrochloric acid to the aqueous raffinate and recontacting with fresh ketone selectively extracts the niobium from the remaining impurities. The process can be accomplished in either single-stage mixer-settler equipment or in the multistage pulse column. This extraction process accomplishes the separation of high-purity metals from the starting material, regardless of the total metal content or the relative tantalum-to-niobium ratio of the ores, thereby allowing for the use of large stocks of low-grade ores, or ores in which the metal ratio is below a marketable value. (auth)

3706

A SELECTIVITY SCALE FOR SOME MONOVALENT CATIONS ON DOWEX 50. O. D. Bonner, (Univ. of South Carolina, Columbia). *J. Phys. Chem.* **58**, 318-20(1954) Apr.

Equilibrium studies involving lithium, hydrogen, sodium, ammonium, potassium, and silver ions on Dowex 50 resins of approximately 4 and 16% divinyl benzene content have been made while maintaining a constant ionic strength of approximately 0.1M. These results are compared with those reported previously for an approximately 8% divinyl benzene resin, and a quantitative selectivity scale has been established for these resins. (auth)

SORPTION PHENOMENA

3707

Mound Lab.

FIXATION OF MIXED FISSION PRODUCT ACTIVITY BY SOILS OF THE SAVANNAH RIVER PROJECT. T. C. Tesdahl, C. S. Lowe, F. C. Mead, and E. L. Murphy. Feb. 25, 1952. Decl. with deletions Nov. 19, 1953. 18p. Contract AT-33-1-GEN-53. (AECD-3629; MLM-665)

The characteristics of fission-product absorption was determined for samples of soil from the tank-farm area of the Savannah River Project. Data are tabulated and presented graphically. (C.H.)

3708

THE ADSORPTION OF GASES ON CALCIUM FLUORIDE. Harold Edelhoach and Hugh S. Taylor (Princeton Univ., N. J.). *J. Phys. Chem.* **58**, 344-50(1954) Apr.

Isotherms of argon and oxygen, nitrogen and carbon monoxide, and xenon and propane, in the neighborhood of liquid oxygen and nitrogen boiling points, on sintered and ground calcium fluoride powders have been determined. Marked inflections in the isotherms for argon and oxygen were found. Nitrogen and carbon monoxide conformed to the BET equation (Type II). With xenon and propane, the data fall on a single smooth curve of adsorbed volume vs. relative pressure. The data have been examined in terms of two-dimensional changes of state, horizontal interactions, and derived thermodynamic data. (auth)

SPECTROSCOPY

3709

THE ABSORPTION SPECTRA OF AQUEOUS SOLUTIONS OF SALTS AND COMPLEX COMPOUNDS OF THORIUM. [Yu. M. Tolmachev]. Translated from *Izvest. Akad. Nauk S.S.S.R. Otdel Khim. Nauk*, 320-4(1944). 7p. (AEC-tr-1879)

The absorption spectra of aqueous solutions of carbonic thorium complex compounds and of thorium chloride and sulfate were studied. On the basis of spectroscopic regularities which relate the absorption spectra to the structures of inorganic complex compounds, the structure of the carbonic thorium complex and the formation of the complex ions in a solution of thorium chloride is postulated. A satisfactory curve for the absorption coefficient was obtained. (auth)

SYNTHESES

3710

Harvard Univ.

PHOSPHORUS TRIPSEUDOHALOGEN COMPLEXES OF NICKEL (O). G. Wilkinson. Mar. 30, 1954. 5p. Contract AT-(30-1)-1461. (NYO-6380)

Tetrakis (phosphorus tri-isocyanate) nickel(O) and tetrakis (phosphorus triisothiocyanate) nickel(O) have been prepared, and some of their properties are described. (auth)

3711

Atomic Energy Project, Univ. of Rochester

THE SYNTHESIS OF δ -AMINOVALERIC ACID- δ -C¹⁴. Morton Rothstein. Apr. 1, 1954. 9p. Contract W-7401-eng-49. (UR-323)

δ -Aminovaleric acid- δ -C¹⁴ has been prepared by treating ethyl γ -bromobutyrate with KC¹⁴N and then catalytically reducing the resulting nitrile. The yield of δ -aminovaleric acid- δ -C¹⁴ was 59% taking into account the recovery of 36% of unutilized KC¹⁴N in the cyanation reaction. (auth)

TRANSURANIC ELEMENTS AND COMPOUNDS

3712

Radiation Lab., Univ. of Calif., Berkeley

CHELATING AGENTS APPLIED TO ION EXCHANGE SEPARATIONS OF AMERICIUM AND CURIUM. Richard A. Glass. Mar. 23, 1954. Decl. May 12, 1954. 11p. (UCRL-2521)

The elution of trivalent Am and Cm from cation exchange columns with tartrate and lactate solutions is reported. The column elutions with 0.1M tartrate solution adjusted to a pH of 4.0 with NH₄OH gave a separation factor of 1.30 between Am and Cm at room temperature. The contamina-

tion was less than 0.2%. A 0.4M lactic acid solution adjusted to a pH of 4.6 gave a separation factor of 1.19 with a contamination of about 2%. A study of the relative efficiencies of four related chelating acids was made. (J.S.R.)

URANIUM AND URANIUM COMPOUNDS

3713

Carbide and Carbon Chemicals Co. (K-25)
THE MOLAR POLARIZATION AND NON-IDEALITY OF URANIUM HEXAFLUORIDE VAPOR. Dale W. Magnuson. Apr. 26, 1954. 14p. Contract W-7405-eng-26. (K-1118)

The molar polarization of UF_6 vapor has been found to be constant over the temperature range of 53 to 132°C, $P_m = 31.034$ cc, by a microwave dielectric constant technique. Thus, the dipole moment is 0. The nonideality, A , in the gas law $P(1 + AP)/V = RT$ has been evaluated in the same temperature interval and can be represented by the equation $A(\text{atm.}^{-1}) = 1.2328 \times 10^6 T^{-3}$. The molar polarization and nonideality of benzene vapor were evaluated at 78.5°C and found to be $P_m = 26.974$ cc and $A = 0.0357 \text{ atm.}^{-1}$, respectively. (auth)

3714

THE COMPLEXITY OF URANIUM(IV) CHLORIDE, BROMIDE AND THIOCYANATE. Sten Åhrland and Ragnar Larsson (Univ. of Lund, Sweden). *Acta Chem. Scand.* 8, 137-50(1954). (In English)

The complexes of the chloride, bromide and thiocyanate systems of uranium (IV) are determined from measurements of the UO_2^{2+}/U^{4+} redox couple utilizing the known values of complexity of the corresponding uranyl systems. The measurements are performed at 20°C in a perchlorate medium of the ionic strength 1C. A constant acidity is maintained which is chosen so high ($[H^+] = 600 \text{ mC}$) that no hydrolysis exists. In order to bring about the necessary acceleration of the potential adjustment, an addition of indigotetrasulfonate is found suitable. The conditions necessary for a proper use of such mediators are discussed. Only mononuclear complexes seem to exist in the systems investigated. For the chloride and bromide systems only the first complex can be certainly proved. The constants found are 2 C^{-1} and 1.5 C^{-1} respectively. In the thiocyanate system, the first two complexes are certainly proved and possibly the third one also exists. The following constants are computed $\gamma_1 = 31 \text{ C}^{-1}$, $\gamma_2 = 90 \text{ C}^{-2}$ and $\gamma_3 \approx 150 \text{ C}^{-3}$. (auth)

3715

THE COMPLEXITY OF URANYL FLUORIDE. Sten Åhrland and Ragnar Larsson (Univ. of Lund, Sweden). *Acta Chem. Scand.* 8, 354-5(1954). (In English).

The fluoride complexes of UO_2^{+2} were studied by an investigation of the free ligand concentration $[A]$ at 25°C and with $C_H = 5, 10, 15$, and 25 mC and C_A increasing up to $\sim 335 \text{ mC}$ in every series. The dissociation constants β_1 and β_2 of the mononuclear complexes HA and HA_2 were determined, and the ligand number \bar{n} of UO_2^{+2} was calculated. The formation function approaches $\bar{n} = 4$, indicating that the upper limit of the complex series is $UO_2F_4^{2-}$. The constants of the first four complexes are calculated. (J.S.R.)

3716

SOME SELENIUM AND TELLURIUM COMPOUNDS OF URANIUM. Riccardo Ferro (Univ. of Genoa, Italy). *Z. anorg. u. allgem. chem.* 275, 320-6(1954) Apr. (In German)

The preparation and properties of the selenide and telluride of U were investigated. $USe(a = 5.739 \text{ kX})$ and $UTe(a = 6.151 \text{ kX})$ display a NaCl structure. The possibility of the formation of solid solutions of $U(As, Se)$ and $U(Sb, Te)$ was investigated, and the lattice constants of the mixed crystals were determined. U_3Te_4 is cubic (Th_3P_4 type

with $a_0 = 9.378 \text{ kX}$), UTe_2 is tetragonal ($a = 3.998 \text{ kX}$, $c/a = 1.865$), $UOSe$ is tetragonal (PbFCl type with $a = 3.893 \text{ kX}$ and $c/a = 1.789$). Preparation of $UOSe$ was described. (tr-auth)

ENGINEERING

HEAT TRANSFER AND FLUID FLOW

3717

INSTABILITY OF FLOW DURING NATURAL AND FORCED CIRCULATION. M. Ledinegg. Translated by R. B. Lees from *Wärme*, 61, 891-8(1938). 24p. (AEC-tr-1861)

The flow in parallel-connected heated boiler tubes lying between two collecting tubes can become unstable under certain conditions. For forced-circulation and filter boilers or for pre-evaporators the course of the tube-friction losses play the most important role; for cooling mantles on heat chambers with natural circulation, the buoyancy relations are the most important. The conditions for the appearance of instability are studied for both cases. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

3718

Massachusetts Inst. of Tech.
STUDY OF METAL-CERAMIC INTERACTIONS AT ELEVATED TEMPERATURES. QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING APRIL 1, 1954. F. H. Norton, W. D. Kingery, et al. Apr. 1, 1954. 12p. Contract AT(30-1)-1192. (NYO-6294)

Surface tension measurements of P_2O_5 have been completed. Surface tension and contact angle determinations have been improved in ease and precision by completion of arrangements for employing a larger sample size and modified camera assembly. Additional surface tension and contact angle measurements of nickel, iron, and iron-carbon alloys have been completed. (For preceding period see NYO-6292.) (auth)

GEOLOGY AND MINERALOGY

3719

California Univ., [Berkeley]
THE GEOLOGY OF THE EASTERN HALF OF THE DIAMOND BUTTE, QUADRANGLE, GILA COUNTY, ARIZONA (thesis). Russell Gordon Gastil. [1950] 155p. (AECU-2861)

3720

Bureau of Mines, Fuels Technology Div., Laramie, Wyo.
RETORTING CHATTANOOGA, TENNESSEE OIL SHALE. ENTRAINED-SOLIDS RETORT RUN 26-1400°F. Dec. 1953. 23p. Contract AT(49-1)-534. (BM-OSRD-68)

3721

Bureau of Mines, Fuels Technology Div., Laramie, Wyo.
RETORTING CHATTANOOGA, TENNESSEE OIL SHALE. ENTRAINED-SOLIDS RETORT RUN 38-1600°F. [1953] 22p. Contract AT(49-1)-534. (BM-OSRD-69)

3722

Bureau of Mines, Fuels Technology Div., Laramie, Wyo.
RETORTING CHATTANOOGA, TENNESSEE OIL SHALE. ENTRAINED-SOLIDS RETORT RUN 40-1715°F. Jan. 1954. 22p. Contract AT(49-1)-534. (BM-OSRD-70)

3723

Division of Raw Materials, AEC
GEOLOGIC AND RADIOMETRIC RECONNAISSANCE OF NORTH PARK, JACKSON COUNTY, COLORADO. Erwin C. Winterhalter. Nov. 1953. 10p., 1 illus. (RME-1008)

3724

Division of Raw Materials, AEC
PRELIMINARY EXAMINATION OF THE HANOSH MINES PROPERTY, MONTICELLO, NEW MEXICO, AND RECONNAISSANCE OF OTHER FLUORITE PROPERTIES IN GRANT, LINCOLN, SIERRA, AND SOCORRO COUNTIES, NEW MEXICO. Harold D. Wolfe. Nov. 1953. 14p. (RME-1020)

3725

Columbia Univ.
FRACTURE STUDIES IN THE LUCERO UPLIFT, NEW MEXICO. FINAL REPORT. Robert W. Duschatko. Dec. 1953. 19p. Contract AT(30-1)-1195. (RME-3072)

The Lucero uplift is a transitional tectonic element situated along the boundary of the Colorado Plateau and the Rio Grande graben belt of central New Mexico. The eastern margin of the structure has been complexly faulted during two (or more) periods of Tertiary deformation. Evidence is presented in support of the hypothesis that both stages of tectonic development involved primarily vertical movement along sharp monoclinical flexures possibly emanating from displacement along deep seated fracture zones. The composite fracture pattern developed over the uplift indicates that the faults and joints are essentially parallel and were produced by a common cause. The dominant fracture pattern is regional and indicates primary east-west lateral elongation with secondary north-south stretching of the sediments due to bending of the rock between the primary fractures. (auth)

3726

Geological Survey
GEOLOGIC INVESTIGATIONS OF RADIOACTIVE DEPOSITS, SEMI-ANNUAL PROGRESS REPORT, JUNE 1 TO NOVEMBER 30, 1953. Dec. 1953. 281p. (TEI-390)

A general survey of the program of geologic studies in the U. S. is presented. The work consisted of a search for and geology of U in sandstone type deposits, veins, igneous and carbonaceous rocks, and in phosphate. The search for Th and monazite deposits is also reported. (For preceding period see TEI-330.) (J.E.D.)

METALS AND METALLURGY

3727

Massachusetts Inst. of Tech.
RESEARCH ON MECHANICAL PROPERTIES OF SINTERED ALUMINUM POWDER. PROGRESS REPORT NO. 3 FOR THE PERIOD MARCH 1953-JULY 1953. WROUGHT SINTERED NICKEL ALLOY PRODUCTS. Eric Gregory, Walter Cremens, and Nicholas J. Grant. 6p. Contract AF 33(616)-284. (AD-18064)

Fabrication of a 5% Al-Ni alloy and results of stress-rupture tests on the material at 1500°F are given. Microstructures of the extruded alloy at 2000 and 20,000 X are shown. (J.A.G.)

3728

Battelle Memorial Inst.
DEVELOPMENT OF MAGNESIUM-LITHIUM STRUCTURAL ALLOYS. FINAL REPORT. P. D. Frost, V. S. Emler, and J. H. Jackson. July 31, 1951. 87p. Contract N0a(s)9526. (ATI-123450)

3729

North American Aviation, Inc.
PRECIPITATE KINETICS AND STRUCTURE IN A METASTABLE ALLOY OF IRON IN COPPER. J. M. Denney.

May 1, 1954. 21p. Contract AT-11-1-GEN-8. (NAA-SR-270)

The precipitation kinetics of a 2.4 wt. % iron in copper alloy were studied for temperatures in the range 600 to 800°C. The iron precipitate obtained by aging in this range was found to be f.c.c., paramagnetic, and coherent with the copper matrix. The precipitate is structurally metastable, transforming to a ferromagnetic structure if plastically deformed. This transition structure anneals to the stable f.c.c. form of iron. A description of the experimental method of measuring the saturation magnetization is given together with an analysis of such measurements. (auth)

3730

Lewis Flight Propulsion Lab., NACA
PROPERTIES OF CERTAIN INTERMETALLICS AS RELATED TO ELEVATED-TEMPERATURE APPLICATIONS. 1. MOLYBDENUM DISILICIDE. W. A. Maxwell. Oct. 6, 1949. 27p. (NACA-RM-E9G01)

3731

Lewis Flight Propulsion Lab., NACA
EFFECT OF HEAT TREATMENT UPON THE MICROSTRUCTURE AND HARDNESS OF WROUGHT COBALT-BASE ALLOY STELLITE 21 (AMS 5385). F. J. Clauss and J. W. Weeton. Sept. 4, 1953. 26p. (NACA-TN-3107)

An investigation of the response of wrought Stellite 21 to heat treatment was made. A period of 72 hours at 2250°F was sufficient for effective solution treatment of this alloy. Pearlitic structures formed at grain boundaries of solution-treated specimens during isothermal transformation at 1950, 1750, and 1500°F. A Widmanstaetten structure also formed during transformation at 1750 and 1500°F. Little visible precipitate formed by transformation at 1200°F for times up to 72 hours. Water quenching from 2250°F followed by aging at temperatures from 1200 to 1950°F resulted in precipitation principally along slip lines and twin boundaries. Spheroidization and agglomeration of precipitates occurred at temperatures as low as 1500°F. Isothermal or aging treatments above 1200°F increased the hardness of the solution-treated specimens. A maximum hardness of Rockwell C-42 was developed by aging 72 hours in the temperature range from 1400 to 1500°F, as compared to Rockwell C-20 to C-22 for the solution-treated condition. Overaging or softening occurred within 72 hours at temperatures of 1750°F and above for aging, and 1950°F for isothermal transformation. (NACA)

3732

Lewis Flight Propulsion Lab., NACA
RELATION OF MICROSTRUCTURE TO HIGH-TEMPERATURE PROPERTIES OF A WROUGHT COBALT-BASE ALLOY STELLITE 21 (AMS 5385). F. J. Clauss and J. W. Weeton. Dec. 15, 1953. 49p. (NACA-TN-3108)

An investigation was conducted to determine the effects of microstructure on stress-rupture life of heat-treated wrought Stellite 21. Wrought Stellite 21, which may be considered a typical cobalt-base precipitation-hardening alloy, was found to respond readily to solution treatment and to isothermal and aging heat treatments to form pearlitic and Widmanstaetten structures as well as scattered precipitates. The results obtained in this investigation, although determined specifically for the alloy wrought Stellite 21, lead to conclusions that are believed to have general significance in the heat treatment of other high-temperature alloys. The optimum high-temperature properties are associated with a dispersion of fine precipitate scattered throughout the grains of the microstructure. Such scattered precipitation was produced by solution treatment followed by a low-temperature aging treatment to develop nucleation sites and higher-temperature age to develop visible precipitation in the scattered nucleation sites. (auth)

3733

Lewis Flight Propulsion Lab., NACA
AN INVESTIGATION OF LAMELLAR STRUCTURES AND
MINOR PHASES IN ELEVEN COBALT-BASE ALLOYS
BEFORE AND AFTER HEAT TREATMENT. J. W.
Weeton and R. A. Signorelli. Dec. 15, 1953. 50p. (NACA-
TN-3109)

3734

National Bureau of Standards
FINAL REPORT ON PROJECT ON ELECTROPOLISHING
OF METALS. Nov. 20, 1952. 15p. (NBS-2070)

3735

Metals Research Lab., Case Inst. of Tech.
AN INVESTIGATION OF THE KINETICS OF THE BAINITE
REACTION IN ALLOY STEELS. SUMMARY REPORT NO. 1.
CHARACTERISTICS AND STABILIZATION OF THE BAINITE
REACTION. R. F. Hehemann and A. R. Troiano. Feb. 1954.
70p. Contract Nonr-763(00). (NP-5146)

Kinetically, the bainite reaction in steels is characterized by a relatively rapid transformation which begins after an induction period, proceeds isothermally, and then comes to a halt without necessarily resulting in complete decomposition of the austenite. This remaining untransformed austenite may remain dormant for extended lengths of time. A characteristic temperature exists above which austenite will not transform into bainite. Below this temperature the amount of austenite transformed to bainite increases as the transformation temperature is lowered. A lower temperature limit also below which it may be possible to obtain complete decomposition of the austenite to bainite. If austenite is reacted in the bainite range at a temperature where the transformation does not result in complete decomposition, then additional transformation may be obtained by subsequent reaction at a lower temperature. Reaction at the lower temperature is retarded by the prior treatment, and a smaller amount of austenite is decomposed by the bainite reaction. This stabilization phenomenon is most readily recognized by the requirement for a new induction period at the lower temperature. Interpretation of these results is based on a mechanism involving a limitation in the nucleation and growth of bainite plates. (auth)

3736

Minerals Research Lab., Inst. of Engineering Research,
Univ. of Calif., Berkeley
ACTIVATION ENERGIES FOR CREEP OF CADMIUM, INDIUM,
AND TIN. R. E. Frenkel, O. D. Sherby, and J. E. Dorn.
Apr. 15, 1954. 13p. Contract N7-onr-295, T.O. 2, Technical
Report No. 36. (NP-5147)

It is shown that the total plastic strain for high-temperature creep of cadmium, indium, and tin under constant load is a function of $t \exp(-\Delta H/RT)$, where t = time under stress, ΔH = activation energy for creep, R = gas constant, and T = absolute temperature. The activation energies for these metals were found to be 22,000, 16,500, and 21,000 cal/mole, respectively. (auth)

3737

Sylvania Electric Products, Inc., Atomic Energy Div.
SELF-DIFFUSION OF METALS AND ASSOCIATED PHENOMENA. PART 9. PROGRESS REPORT [FOR] OCTOBER
1, 1952 TO APRIL 1, 1953. R. W. Balluffi, F. D. Rosi,
and L. L. Seigle. Apr. 5, 1954. 9p. Contract AT-30-1-
GEN-367. (SEP-151)

Observations are being made of porosity formation and dimensional changes occurring during the dezincification of thin sheets of alpha brass possessing different grain sizes. Measurements of intrinsic diffusion coefficients in the silver-gold, copper-nickel, and copper-zinc systems are continuing. More detailed consideration has been given to satisfaction of boundary conditions and criteria for poros-

ity formation in vapor-solid diffusion couples. The activation energy for the rate of rounding of gold points in vacuum has been established at a value midway between that for self-diffusion and evaporation. Determination of sintering rates of silver powders has not confirmed the existence of a scale factor. Results from both of these investigations, however, are not entirely satisfactory. Investigations of the effect of solute elements on the stress-strain characteristics of single copper crystals indicate that an increase in the amount of substitutionally dissolved solute increases both the definition of the yield point and the critical shear stress for slip and decreases the shear hardening rate. (auth)

3738

Armour Research Foundation
TITANIUM PHASE DIAGRAMS. Harold D. Kessler,
William Rostoker, and Robert J. Van Thyne. Nov. 1953.
95p. Contract AF-33(038)-8708. (WADC-TR-52-335)

Using high-purity arc-melted alloys and micrographic analysis of annealed samples as the principle method of investigation, titanium-rich, partial phase diagrams were determined for the following systems: Ti-Cr-Fe: The titanium-rich portion of the diagram was studied in detail to 70 weight % titanium. The isotherm at 800°C was determined for the section bounded by Ti, TiFe₂, and TiCr₂. The solubility of chromium and iron in alpha titanium is less than 1% total alloy content. There is a continuous space of ternary beta solid solution between the Ti-Cr and Ti-Fe systems. A ternary eutectoid, $\beta = \alpha + \text{TiCr}_2 + \text{TiFe}$, occurs at approximately 8% Cr-13% Fe and about 540°C. The beta phase of alloys lying on the low titanium side of a tie line between 7% chromium and 4% iron is retained upon water quenching from the beta space. Hardness data are presented, illustrating the marked effect of heat treatment. Ti-Al-O and Ti-Al-N: Titanium-rich corners of the systems from 0 to 10% aluminum and 0 to 1% oxygen or nitrogen were investigated. As aluminum, oxygen, and nitrogen are alpha stabilizers, the ternary alpha spaces extend to temperatures well above the transformation temperature of titanium (885°C). Nitrogen is more effective than oxygen in raising the $\beta/\alpha + \beta$ space boundary of the Ti-Al system. Upon water quenching the alloys, the beta phase transforms to alpha prime. Oxygen and nitrogen additions increase the hardness of the Ti-Al alloys. Ti-Al-C: The phase diagram was determined using alloys containing 0 to 10% aluminum and 0 to 1% carbon. A study of several as-cast carbon master alloys permitted an outline of the Ti-C diagram to be constructed. A high melting compound, TiC, appears to exist over a range of compositions. A eutectic occurs at about 30% carbon between TiC and carbon. Aluminum raises the temperature of the peritectoid reaction of the Ti-C system, $\beta = \alpha + \text{TiC}$ (920°C). The maximum solubility of carbon in alpha titanium is increased by aluminum additions from about 0.5% in the binary Ti-C system to 1 at 10% aluminum. Aluminum and carbon increase the hardness of the alpha solid solution. Ternary Oxide Phases: A family of ternary oxide phases isomorphous with Fe₃W₂C was discovered in which titanium was associated with one of the elements of the first transition series. The phase relationships between these ternary phases and binary phases were investigated for the Ti-Cr-O, Ti-Fe-O, and Ti-Ni-O systems. An isothermal section for the Ti-Mo-O system was constructed. (auth)

3739

Michigan Univ.
THE INFLUENCE OF SURFACE TREATMENT ON THE
FATIGUE PROPERTIES OF TITANIUM AND TITANIUM
ALLOYS. Lars Thomassen, Maurice J. Sinnott, and Albert

W. Demmler, Jr. Feb. 1954. 68p. Contract AF 33(616)-26. (WADC-TR-53-437)

3740

Engineering Research Inst., Univ. of Mich.
[INVESTIGATION OF MACHINABILITY OF TITANIUM-BASE ALLOYS]. REPORT NO. 10. CUTTING FORCES AND SURFACE FINISH WHEN BROACHING TITANIUM WITH HIGH-SPEED-STEEL TOOLS. L. V. Colwell and R. E. McKee. May 1953. 59p. Contract DA-20-018-ORD-11918. (WAL-401/109-10)

An investigation was made of conditions for satisfactory surface broaching of titanium. The feed rate or rise per tooth was varied in combination with the rake angle. All tests were made on a commercial broaching machine. The materials tested were Ti-75A, Ti-150A, and RC-130B titanium and hot-rolled SAE 1045 steel. Titanium is highly sensitive to both rake angle and relief angle on the broaching cutter. Rake angle should be at least 5°, and the relief angle should be from 3 to 5°. Surface finish is excellent unless the relief angle is made too small. Broaching cutters will withstand tooth loads as high as 0.005 ipt. (auth)

3741

THE TERNARY SYSTEM: COPPER-SILVER-CADMIUM. L. Losana and C. Gorla. Translated by Albert Milanesi from *Industria chimica* 9, 1603-15(1934). 15p. (AEC-tr-1862)

The ternary system Cu-Ag-Cd is examined from a thermal and micrographic viewpoint. The formation of ternary compounds of primary crystallization is excluded, and the areas of existence of numerous constituents are determined. The structure of solid alloys is very complex, and it is strictly related to cooling speed. Further experiments intended to clarify some dubious points are presently under way. Some alloys, presenting a very reduced solidification area, may be used in the production of special thermal safety fuses. Phase diagrams of the binary systems are also presented. (auth)

3742

"MEAN STRAINS" IN WORKED ALUMINIUM. P. Gay and A. Kelly (Cavendish Lab., Cambridge, England). *Acta Cryst.* 7, 333-6(1954) Apr.

Experiments have been carried out to investigate the cause of the relative radial displacements of adjacent diffraction spots on some x-ray microbeam back-reflection photographs of rolled polycrystalline aluminum. Among other causes, it is possible that the displacements are due to the existence, within the material, of particles in which the lattice spacing is different from the average value. From the present experiments it is concluded that a few reflections from such particles have been found. The stress required to produce strains of the observed magnitude are of the order of the yield stress of the material. (auth)

PHYSICS

3743

Los Alamos Scientific Lab.
THE STRUCTURE OF A STEADY-STATE PLANE DETONATION WAVE WITH FINITE REACTION RATE. John G. Kirkwood, Sterling [Chemistry] Lab., Yale Univ. and William W. Wood, Los Alamos Scientific Lab. [1953?]. Dec. Apr. 22, 1954. 20p. Contract [W-7405-eng-36]. (AEC-3626)

An analytical elaboration of von Neumann's model of the detonation wave is presented. A hydrodynamic argument for the well known Chapman-Jouguet condition is advanced, and the sound speed to be used is identified as that obtained with

frozen chemical equilibrium, in agreement with a recent result of Brinkley and Richardson. Possible situations in which the classical Chapman-Jouguet hypothesis might be incorrect are very briefly discussed. (auth)

3744

Los Alamos Scientific Lab.
DETERMINATION OF THE ALPHA COUNTING EFFICIENCY OF SOME FILTER PAPERS. Robert F. Barker. [1953] 8p. Contract [W-7405-eng-36]. (AECU-2853)

An investigation was made to determine the effect the deposition of the material within the filter paper had upon the alpha counting efficiency for a given amount of material collected. Thoron was generated, from thorium, in a closed chamber and samples of the thorium-B daughter were collected on 4½-inch by 9-inch filter papers. Thorium-B and its decay products release one alpha particle and two beta particles for each thorium-B atom which decays. Alpha and beta counts were made on individual samples. The alpha to beta ratio for most of the papers tested did not vary more than 10% for flow rates of from 7 linear feet per minute to a maximum, depending on the type of paper used, of from 27 to 75 linear feet per minute. (auth)

3745

DIELECTRIC PERMEABILITY AND ITS TEMPERATURE DEPENDENCE FOR CRYSTALS OF THE TYPE OF RUTILE AND PEROVSKITE. G. I. Skanavi. Translated from *Doklady Akad. Nauk S.S.S.R.* 59, 231-4(1948). 10p. (AEC-tr-178)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 1-1808.

3746

PHOTOEFFECT AND SECONDARY EMISSION OF CATHODES CONSISTING OF ALLOYS. N. M. Gopstein and D. M. Khorosh. Translated from *Zhur. Tekh. Fiz.* 8, 2103-6(1938). 7p. (AEC-tr-1618)

A study of the photoeffect and secondary emission of cathodes consisting of alloys of Cs with Sb, Bi, As, Te, and P was made. The integral sensitivity and coefficient of secondary emission are given. Methods of preparation and photoelectric and dynatronic properties are discussed. (J.E.D.)

3747

SOME OPTICAL CHARACTERISTICS OF Cs-Sb PHOTO-CATHODES. N. Ya. Karkhanin and N. D. Morgulis. Trn Translated from *Zhur. Tekh. Fiz.* 20, 346-52(1950). 14p. (AEC-tr-1619)

3748

THE MECHANISM OF PHOTO-ELECTROCHEMICAL PROCESSES ON Ag-Ag₂ ELECTRODE. V. I. Veselovskii. Translated from *Zhur. Fiz. Khim.* 22, 1302-11(1948). 21p. (AEC-tr-1626)

3749

NEW FEATURES OF THE TRANSFER EFFECT THROUGH THE HELIUM II FILM. B. N. Eselson [Yesel'son] and B. G. Lazarev. Translated from *Zhur. Eksptl'. Teoret. Fiz.* 23, 552-63(1952). 22p. (AEC-tr-1882)

The transfer through the He II film was studied under conditions which lead to a minimum of normal evaporation and contamination of the walls of the flask by solid impurities, under improved shielding of the flask from thermal radiation, and the damping of temperature fluctuations which arise from pumping. The dependence of the rate of transfer on the height of the film and on the procedure of filling the flask with helium was established. It is shown that the rates of outflow and inflow differ. The rapid fall of the rate of outflow in the initial and final stages of the process was studied. (auth)

3750

ON THE DISPLACEMENT OF THE CRITICAL TEMPERA-

TURES OF SUPERCONDUCTORS BY PRESSURE. N. E. Alekseevskii [Alekseevski] and N. B. Brandt. Translated from *Zhur. Eksptl'. i Teoret. Fiz.* **22**, 200-03(1952). 6p. (AEC-tr-1883)

The effect of hydrostatic compression on the displacements of the critical temperatures (T_k) was investigated for two intermetallic compounds (Au_2Bi and Bi_2K) which have the same type lattice with nearly equal parameters. An increase in T_k upon hydrostatic compression was observed for the compound Bi_2K . A hypothesis is proposed concerning the existence of a maximum in the curve of the dependence of T_k of superconductors on their electron concentrations. (auth)

3751

RADIATION STERILIZATION. VIII. FISSION PRODUCT KILOCURIE SOURCE: PREPARATION, RADIATION INTENSITY. J. W. Loeding, E. J. Petkus, G. Yasui, W. A. Rodger, I. G. Dillon, and L. Burris (Argonne National Lab., Lemont, Ill.). *Nucleonics* **12**, No. 5, 14-20(1954) May.

An experimental radiation source is described which contains about 2,000 c of mixed gross fission products, with an average age of about 1 year, incorporated into a hollow concrete cylinder. The γ dose rate, as measured by chemical dosimetry, is about 10^4 r/hr. A mathematical study was made of the effects of variations in source geometry and energy on the radiation intensity along the center line of the cavity in the source. Methods used in calculating the dose rate from a hollow cylindrical source are discussed. (C.H.)

3752

A SOURCE OF DOUBLY IONIZED HELIUM. Richard Geller and François Prevot. *Compt. rend.* **238**, 1578-80(1954) Apr. 12. (In French)

An apparatus is described for producing an intense beam of α particles by a charge exchange method, using He^+ ions supplied by a Van de Graaff accelerator. (K.S.)

3753

NEUTRON DIFFRACTION STUDY OF THE FERROELECTRIC MODIFICATION OF POTASSIUM DIHYDROGEN PHOSPHATE. Henri A. Levy and S. W. Peterson (Oak Ridge National Lab., Tennessee) and S. H. Simonsen (Univ. of Texas, Austin). *Phys. Rev.* **93**, 1120-1(1954) Mar. 1

The ferroelectric modification of KH_2PO_4 which exists at temperatures below $121^\circ K$ was examined by single-crystal neutron-diffraction techniques at $113^\circ K$. Complete data from the (hhl) zone of a cylindrical specimen cut parallel to this zone axis were collected at neutron wavelength 1.062 \AA to $\sin\theta/\lambda = 0.77$. The results show conclusively that the arrangement of hydrogen atoms is ordered. The hydrogen atoms are situated 1.07 \AA from oxygen atoms O_1 , nearly along the hydrogen bonds. The length of the phosphorus-to-hydroxyl-oxygen link is 1.56 \AA , while that of the other P-O link is slightly shorter, 1.53 \AA . The length of the hydrogen bond, O-H...O, is 2.50 \AA . All of these distances are close to those existing in the tetragonal room-temperature modification, where the hydrogen atoms are probably disordered. (auth)

3754

THE HEAT CAPACITY AND ENTROPY OF LIQUID He^3 FROM $0.42^\circ K$ TO $1.06^\circ K$. Darrell W. Osborne, Bernard M. Abraham, and Bernard Weinstock (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **94**, 202-3(1954) Apr. 1.

Preliminary measurements have been made on the heat capacity of liquid He^3 between 0.42 and $1.06^\circ K$. These results, when combined with vapor pressure and melting pressure data, show that the entropies of both the liquid and the solid are approximately $R \ln 2$ at $0.42^\circ K$,

and it is concluded that there is no appreciable alignment of the nuclear spins in either liquid or solid He^3 down to $0.42^\circ K$. (auth)

3755

THE HEAT OF MIXING OF He^3 AND He^4 SOLUTIONS. V. S. Nanda (Ohio State Univ., Columbus). *Phys. Rev.* **94**, 241-3(1954) Apr. 15

None of the current theories of He^3 and He^4 solutions is really satisfactory. In order to decide which of these makes the correct approach to the problem, experiments on the heat of mixing can be very useful. It is shown that various theories predict remarkably different behavior for this quantity. In particular, de Boer and Gorter theory gives rather high values for heat of mixing per mole of He^3 . A comparison of the theoretical and experimental results should thus show clearly the need of Taconis hypothesis in explaining the various properties of He^3 and He^4 solutions. (auth)

3756

THE THEORY OF LIQUID HELIUM. G. V. Chester (King's Coll., London, England). *Phys. Rev.* **94**, 246-52 (1954) Apr. 15.

The free energy, F , of an assembly of interacting He atoms is expressed in terms of the trace of the density operator, $\exp(-\beta H)$, where $\beta = 1/kT$, H is the Hamiltonian, and T the temperature. The Hamiltonian is written as $H_0 + gW$, where H_0 is the part corresponding to the kinetic energy and gW the potential energy. The resulting expression for F is expanded in powers of g , the first two terms of the series being calculated explicitly. The first term, which is independent of g gives the free energy of the London theory and leads to all the usual results. In particular, the transition at the λ , temperature, T_λ , is of the third order. The second term in the expansion of F raises the transition to one of the second order; all the second-order derivatives of this term are discontinuous at T_λ , while T_λ and $\partial T_\lambda / \partial \rho$ are the same as in the London theory. Numerical values are obtained for the specific heat and the discontinuity in the specific heat. These are compared with experiment, and it is found that there is an improvement as compared with previous theories. (auth)

3757

ATOMIC THEORY OF THE TWO-FLUID MODEL OF LIQUID HELIUM. R. P. Feynman (Calif. Inst. of Tech., Pasadena). *Phys. Rev.* **94**, 262-77(1954) Apr. 15.

It is argued that the wave function representing an excitation in liquid He should be nearly of the form $\sum_i f(r_i) \phi$, where ϕ is the ground-state wave function, $f(r)$ is some function of position, and the sum is taken over each atom i . In the variational principle this trial function minimizes the energy if $f(r) = \exp(ik \cdot r)$, the energy value being $E(k) = \hbar^2 k^2 / 2mS(k)$, where $S(k)$ is the structure factor of the liquid for neutron scattering. For small k , E rises linearly (phonons). For larger k , $S(k)$ has a maximum which makes a ring in the diffraction pattern and a minimum in the $E(k)$ vs k curve. Near the minimum, $E(k)$ behaves as $\Delta + \hbar^2(k - k_0)^2 / 2\mu$, which form Landau found agrees with the data on specific heat. The theoretical value of Δ is twice too high, however, indicating need of a better trial function. Excitations near the minimum are shown to behave in all essential ways like the rotons postulated by Landau. The thermodynamic and hydrodynamic equations of the two-fluid model are discussed from this view. The view is not adequate to deal with the details of the λ transition and with problems of critical flow velocity. In a dilute solution of He^3 atoms in He^4 , the He^3 should move essentially as free particles but of higher effective mass. This mass is calculated, in an appendix, to be about six atomic mass units. (auth)

COSMIC RADIATION

3758

CASCADE PROCESSES IN EXTENSIVE ATMOSPHERIC SHOWERS OF COSMIC RADIATION. I. L. Rozental (Phys.-Cosm. Inst. im. P. N. Lebedeva, Russia). Zhur. Eksptl'. i Teoret. Fiz. 23, 440-55(1952) Oct. (In Russian)

Calculations were made on the characteristics of nuclear cascades generated at high energies. A comparison of calculated and observed path length of the different components of extensive atmospheric showers leads to a more accurate definition of the parameters of elementary events. The parameters are used for the calculation of the average quadratic radius and the spatial distribution of the components of extensive showers. There is satisfactory agreement of the calculated data with the experimental. (tr-auth)

3759

PHOTO-ELECTRIC DETERMINATION OF THE CHARGE OF HEAVY PRIMARIES IN THE COSMIC RADIATION. Berndt Waldeskog (Univ. of Lund, Sweden). Arkiv Fysik 7, No. 5, 475-85(1954). (In English)

A method of determining the charge of heavy nuclei in cosmic radiation is described. It depends on measuring, with the photoelectric method the mean widths of tracks ending in a photographic emulsion. It is shown that the particles are easily divided into groups representing different values of the charge even if a track length of only 300 microns is used. No definitely primary particles with charge $Z = 3, 4$, or 5 have been found. The possibility of finding such particles in the plate packet is discussed. The statistical material available is not enough to decide whether particles with charge $3, 4$, or 5 are present in the primary radiation or not. (auth)

3760

THE TRANSITION EFFECT OF THE NEUTRON LIBERATING COMPONENT OF COSMIC ULTRARADIATION IN CARBON. G. Pfozter and H. M. Weiss (Max-Planck-Institut für Physik der Stratosphäre, Weissenau, Germany). Naturwissenschaften 41, 107-9(1954) Mar. (In German)

The experimental results of a series of experiments with C as the absorber are described. A Pb T sheet was inserted in the place of the photographic plate, and the detection of nuclear evaporation was accomplished by counting the emitted neutrons. According to the explanation presented, the principal constituent of the cosmic radiation is the origin of locally produced electrons from nuclear evaporation so that the neutron intensity emitted under the same experimental conditions is proportional to the thickness of the absorber. (J.S.R.)

3761

ON THE FRAGMENTATIONS OF HEAVY COSMIC RAY NUCLEI. K. Gottstein (Univ. of Bristol, England). Phil. Mag. (7) 45, 347-59(1954) Apr.

In photographic emulsions exposed at 95,000 ft, the reactions of heavy nuclei ($Z \geq 3$) with the nuclei of the emulsions have been studied. The charges and energies of the cosmic-ray nuclei were determined both directly from their multiple scattering and δ -ray densities, or from the variation of δ -ray density with range, and indirectly by measuring the opening angles of the showers of fragments, and the total energy released in the reactions. A survey is given of the different types of reactions observed. The observed frequency of occurrence of heavy fragments ($Z \geq 3$) produced in the encounters of heavier nuclei is in accordance with the results obtained by Peters et al. The charge distribution at the top of the atmosphere is calculated from the one measured below material (air, glass, emulsion) corresponding to 15 to 40 g/cm² of air, using the collision cross section as found by Peters. The influence of

energy loss by ionization is considered. The resulting charge distribution is in approximate agreement with the one measured by Dainton, Fowler, and Kent, the nuclei Li, Be, B being about as frequent as C, N, O, F. The energy distribution agrees with the one obtained by Dainton, Fowler, and Kent. The frequency of meson production in collisions of heavy nuclei is studied. (auth)

3762

A V-DECAY EVENT WITH A HEAVY NEGATIVE SECONDARY, AND IDENTIFICATION OF THE SECONDARY V-DECAY EVENT IN A CASCADE. E. W. Cowan (California Inst. of Tech., Pasadena). Phys. Rev. 94, 161-6(1954) Apr. 1.

Two cosmic-ray decay events have been photographed in a cloud chamber under conditions that yield mass values from combined magnetic-field momentum measurements and ionization measurements from droplet counting. A method has been developed for assigning meaningful probable errors to the ionization measurements. The first event is interpreted as the decay of a neutral V particle into a positive π meson and a negative particle of mass $1850 \pm 250 m_e$. On the assumption of a two-body decay, the Q value for the decay is 11.7 ± 4 Mev. The second event is a cascade decay that can be summarized by the following reaction:

$$Y^- \rightarrow 67 \pm 12 \text{ Mev} + \pi^- + \Lambda^0 \rightarrow 40 \pm 13 \text{ Mev} + \pi^- + p.$$

The proton of the Λ^0 decay is identified by a measured mass of $2050 \pm 350 m_e$. On the assumption of a two-body decay, the mass of the primary V particle is $2600 \pm 34 m_e$. (auth)

3763

COSMIC-RAY PROTONS AT 3.4 KILOMETERS. Charles E. Miller, Joseph E. Henderson, Gerald R. Garrison, David S. Potter, Wayne M. Sandstrom and Jay Todd, Jr. (Univ. of Washington, Seattle). Phys. Rev. 94, 167-73 (1954) Apr. 1.

A magnetic cloud chamber and an appropriate arrangement of coincidence and anticoincidence Geiger counters were used to photograph tracks of charged particles with ranges of 0.4 to 15 cm and 0.4 to 30 cm of lead. The momentum intervals corresponding to these range intervals are sufficiently different for protons and mesons that there resulted a large momentum interval in which only protons were stopped due to ionization losses. At higher momenta, most of the protons were stopped by nuclear interaction because of the large thicknesses of absorber used. At lower momenta, where both protons and mesons were stopped, the protons were distinguished by track density. The result is an accurate proton momentum spectrum for the interval 0.7 to 2.0 be/c, in which it is found that protons form 20 ± 2 percent of all ionizing nonelectronic particles. From the number of protons stopped in 15 and 30 cm of lead the path length for removal of protons in lead by nuclear interaction is calculated to be 206 ± 30 g/cm² in the momentum interval 0.9 to 2.5 be/c. (auth)

3764

COSMIC-RADIATION INTENSITY-TIME VARIATIONS AND THEIR ORIGIN. III. THE ORIGIN OF 27-DAY VARIATIONS. J. A. Simpson (Univ. of Chicago). Phys. Rev. 94, 426-40(1954) Apr. 15. (cf. NSA 7-4159)

It is shown that (a) the 27-day recurring cosmic-radiation intensity variations are not produced by geomagnetic field disturbances, and (b) this 27-day variation is a primary intensity variation produced by a charged-particle accelerating mechanism. These results were obtained without invoking special models for the magnetic field disturbances or requiring detailed time correspondence between cosmic-radiation intensity and magnetic field intensity variations.

The conclusions were based upon experimental observations covering a 19-month period in 1951 and 1952. The results are derived from neutron-intensity variations measured as a function of time in aircraft and neutron monitor piles. The data reveal that an indirect association exists between the 27-day intensity variation and geomagnetic disturbances, i.e., geomagnetic disturbances are most likely to occur approximately 2 days after the 27-day maxima of cosmic-ray intensity. It is also shown that intensity changes of ~3 to 6% are sometimes not followed by any geomagnetic disturbance. An example is given of a nonrecurring sharp intensity decrease of >6%, and it is shown that even this event is not produced by geomagnetic field variations. The results suggest that there is a common mechanism which produces both the accelerating process for cosmic-radiation particles and, indirectly, the geomagnetic disturbances. A search was made for the probable location of such a mechanism. Varying electrical fields of terrestrial origin were considered whereby the incoming primary radiation would undergo an acceleration or deceleration either (1) before entering the geomagnetic field, (2) within the magnetic field region, or (3) after passing through the magnetic field. None of these three possibilities, nor a combined geomagnetic and geoelectric field storm, accounts for all the established experimental facts. In view of these results it is concluded that the accelerating mechanism probably is not of terrestrial origin. The 27-day recurrence corresponds in time to the proper rotation of the solar equatorial latitudes, and, since it has been shown that active solar regions at these latitudes are associated with the 27-day cosmic-radiation intensity variations, the required accelerating mechanism is probably controlled by solar processes and may be located near the sun. From the dependence of the 27-day intensity variation upon particle rigidity, the experimental results show that primary protons undergo the variation, but it is still not proved whether or not particles of $Z \geq 2$ also display this variation. The experimental data also exclude the production of this variation by the influence of a solar dipole magnetic field. (auth)

3765

THE ORIGIN OF COSMIC RAYS. Philip Morrison (Cornell Univ., Ithaca, N. Y.), Stanislaw Olbert and Bruno Rossi (Mass. Inst. of Tech., Cambridge). *Phys. Rev.* **94**, 440-53(1954) Apr. 15.

The isotropy and composition of the primary cosmic radiation suggest that cosmic rays are trapped within the galaxy for an average time of the order of 10^6 years, a long time compared with the time of escape along straight-line paths but short compared with the mean life against nuclear collisions with interstellar matter. If this conclusion is accepted, it appears possible to account for the observed properties of cosmic rays under the assumption that cosmic rays acquire their large energies through a gradual acceleration in space, such as suggested by Fermi. In contrast to the original Fermi theory (which denied any possibility of escape from the galaxy), it is found that the energy spectra of protons and heavier nuclei are approximately the same and that the required injection energies are very modest for all components. However, a much faster rate of acceleration than the original theory required must be assumed. The consequences of the above assumptions on the basis of a specific model are developed, describing the motion of cosmic rays through the galaxy as a random motion between scattering centers represented by moving magnetized clouds. The astrophysical implications of these assumptions and the plausibility of the model are discussed. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

3766

Los Alamos Scientific Lab.

THE CRYSTAL STRUCTURE OF ACTINIUM METAL AND ACTINIUM HYDRIDE. John D. Farr, Angelo L. Giorgi, Melvin G. Bowman, and Richard K. Money. Apr. 1953. Decl. Apr. 7, 1954. 13p. Contract W-7405-eng-36. (LA-1545)

The crystal structures of actinium metal and actinium hydride were determined by analyses of x-ray-diffraction patterns and compared to La and La hydride. Both structures were found to be face-centered cubic with the following lattice constants:

	a_0
Ac	$5.311 \pm 0.010 \text{ \AA}$
AcH ₂	$5.670 \pm 0.006 \text{ \AA}$

Methods of preparation of Ac and La are given. (auth)
3767

North American Aviation, Inc.

DISPLACEMENT ENERGY OF FACE-CENTERED CUBIC IRON. J. M. Denney. May 1, 1954. 26p. Contract AT-11-1-GEN-8. (NAA-SR-271)

The displacement energy of face-centered cubic iron in an alloy of 2.4% iron in copper was found to be $27 \text{ ev} \pm 1 \text{ ev}$. The saturation magnetization of thin foils was observed as a measure of the number of radiation-produced displacements. A comparison of experimental and theoretical energy displacement curves shows satisfactory agreement in form, but the experimental data indicate an increase in saturation magnetization at a rate 200 times faster than would be expected from a simple model of interstitial-induced transformation of the face-centered cubic iron. The rate of change of resistivity with particle energy is discussed to suggest that care is necessary to prevent overestimation of the energy threshold. It is suggested that displacement energy is dependent upon crystallographic direction. (auth)

ELECTRONS

3768

Ames Lab.

TRANSMISSION OF 0-50 KILOVOLT ELECTRONS BY THIN FILMS WITH APPLICATIONS TO BETA-RAY SPECTROSCOPY. Raymond O. Lane and D. J. Zaffarano. Dec. 1953. 75p. Contract W-7405-eng-82. (ISC-439)

The transmission of electrons by thin films as a function of the incident energy of the electrons was measured using thermal electrons which were accelerated across a known potential difference. The electrons transmitted by the film were detected by a Faraday collector. The extrapolation of the linear portions of the transmission curves to zero transmission gave practical values of energy, E_p , for the films which were shown to correspond to practical ranges of electrons in Al as given by Schonland, whose thinnest film was 0.25 mg/cm^2 in area density. The ranges of electrons in films of area density as low as 0.023 mg/cm^2 was measured, which is considerably lower than the area densities reported in previous range-energy measurements. It is found that all values of E_p fall within 15% of those calculated from the relation $E_p = 22.2R^{0.6}$, where E_p is in kev and R is in mg/cm^2 . This relation holds between 1.5 and 25 kev. Transmission experiments on a 0.012 mg/cm^2 collodion film which was not coated with Al indicated that it was essentially a conductor under the conditions of the experiment. Similar measurements on an uncoated 0.3-

mg/cm² Formvar film resulted in a hysteresis effect, indicating a considerable accumulation of charge on the film. One of the Al-coated Formvar films for which the transmission curve had been measured was employed as the window in a G-M counter in a thin-lens β -ray spectrometer. When the transmission curve for the window was applied to the β -ray spectrum of a 0.0002-mg/cm² source of Pm¹⁴⁷ on a 0.006-mg/cm² collodion backing, an over-correction resulted in the Fermi plot. Multiple scattering calculations estimate that most of this over-correction may well be accounted for by the fact that the counter and Faraday collector subtend different solid angles of collection. The Fermi plot of C¹⁴ was found to be linear for energies above 40 kev. The thinnest source had an effective thickness of about 1.5 mg/cm², so that little can be said from this investigation concerning the true shape of the C¹⁴ Fermi plot below 40 kev. (auth)

3769

A CONTRIBUTION TO THE CLARIFICATION OF THE INACCURACY OF SECONDARY ELECTRON MEASUREMENTS. O. Beer (Univ. of Munich, Germany). *Ann. Physik* 14, 201-14(1954) Feb. (In German)

A recording arrangement for the measurement of secondary electrons eliminated the time parameter and reduced the scattering of the measured values. The systematic deviations determined on the basis of increased measuring accuracy were caused by positive ions. The temperature dependence of the number of ions was experimentally determined; a pressure dependence appeared possible, but was not proven. The measurements gave, in the range from 200 to 500°C, a temperature coefficient of < 1% for metals and no velocity dependence of the secondary electrons on the temperature. (tr-auth)

3770

AN EXPERIMENTAL MEASUREMENT OF THE GYRO-MAGNETIC RATIO OF THE FREE ELECTRON. W. H. Louisell, R. W. Pidd, and H. R. Crane (Univ. of Michigan, Ann Arbor). *Phys. Rev.* 94, 7-16(1954) Apr. 1.

The gyromagnetic ratio of the free electron is measured by a method which is an extension of the classical double-scattering experiment. A magnetic field is interposed between the first and second scattering foils, whose direction is parallel to the path followed by the electrons. The electron spins precess in the magnetic field, resulting in a rotation of the plane of maximum asymmetry, as observed after the second scattering event. In the experiment reported, the rotation is approximately 1800 degrees. In the motion of the electron between the two scatterers the small lateral component of velocity gives rise to a "cyclotron" motion whose frequency is, theoretically, the same as the spin precession frequency to within about one part in a thousand. The cyclotron motion, therefore, furnishes a convenient reference frequency, but it also introduces problems in that it causes the asymmetries which have their origin in a geometrical misalignment, finite aperture, etc., to follow the rotation of the spin asymmetry. By comparing all measurements made with the foils of high atomic number with measurements made with an aluminum foil of equal scattering power, and by further precautionary procedures and cross checks, the spin asymmetry is separated from asymmetries of other origin. The result, for 420-kev electrons and gold scatterers, is $g = 2.00 \pm 0.01$. Plans for a more precise measurement are mentioned. (auth)

3771

RANGE MEASUREMENT OF LOW-VOLTAGE ELECTRONS. Marguerite Davis (Yale Univ., New Haven, Conn.). *Phys. Rev.* 94, 243-5(1954) Apr. 15.

Determinations of the ranges of electrons between the

energies of 600 and 2000 v are difficult to perform, since the short ranges of the particles cannot be detected by the usual physical methods. A biologically active molecule such as an enzyme can be used as detector in this energy region, the amount of inactivation in uniform layers of the enzyme being a function of the range of the electron. The ranges of the very low energy electrons determined in this manner were found to be considerably less than those predicted by the Bethe formula for energy loss, if no allowance for scattering and straggling is made. If about 40% loss of range due to this is assumed, then theory and experiment are in fair agreement. Alternatively, a constant correction of 100A to be subtracted from the calculated range brings theory and experiment into agreement. (auth)

GASES

3772

THE INFLUENCE OF BINARY COLLISIONS ON THE MOLECULAR FLOW OF GASES. 1. LONG, CYLINDRICAL TUBES. J. W. Hiby and M. Pahl. Translated by A. S. Berman from *Z. Naturforsch.* 7a, 533-41(1952). 21p. (AEC-tr-1885)

An abstract of this paper combined with part 2 appears in *Nuclear Science Abstracts* as NSA 6-6646.

3773

THE INFLUENCE OF BINARY COLLISIONS ON THE MOLECULAR FLOW OF GASES. 2. NARROW CHANNELS BETWEEN FLAT PLATES; PERFORATED PLATES; SHORT TUBES; POROUS MEDIA. J. W. Hiby and M. Pahl. Translated by A. S. Berman from *Z. Naturforsch.* 7a, 542-53(1952). 26p. (AEC-tr-1886)

An abstract of this paper combined with part 1 appears in *Nuclear Science Abstracts* as NSA 6-6646.

3774

IONIZATION BY RELATIVISTIC μ -MESONS IN OXYGEN. S. K. Ghosh, G. M. D. B. Jones, and J. G. Wilson (Univ. of Manchester, England). *Proc. Phys. Soc. (London)* A67, 331-42(1954) Apr. 1.

The specific ionization in O₂ near atmospheric pressure has been measured over the momentum range 3×10^8 ev/c < p < 3×10^{10} ev/c, excluding collisions involving energy transfers greater than 1 kev. The measurement was based upon drop counts in the positive ion column of tracks in a cloud chamber independent of the system used to measure momentum. Modification of ionization due to polarization phenomena is shown to become important at momenta greater than about 6×10^9 ev/c. (auth)

INSTRUMENTS

3775

Radiation Research Corp.
NUCLEAR BATTERIES. QUARTERLY PROGRESS REPORT NO. 2 [FOR] OCTOBER 15, 1952—JANUARY 15, 1953. J. H. Coleman. 37p. Contract DA-36-039 SC-42564 (AD-5680)

(For preceding period see ATI-171145.)

3776

Los Alamos Scientific Lab.
AN ANALOG COMPUTER FOR THE SOLUTION OF SIXTEEN NONLINEAR EQUATIONS IN FOUR INDEPENDENT VARIABLES. W. L. Briscoe. Apr. 8, 1954. 26p. Contract [W-7405-eng-36]. (AECU-2863)

An analog computer was designed and constructed for the purpose of speeding the laborious process of reducing the residual aberrations in optical lens design. The computer uses photoformers, closed loops using cathode-ray tubes, for the generation of the desired functions. It uses a deflection adder driven by a set of four scales-of-sixty-four to provide an analog of lens bending upon which the

aberrations depend. Finally, the circuit uses a function adder and a push-pull coincidence circuit to establish the regions of satisfactory solution. (auth)

3777

Los Alamos Scientific Lab.

CHARACTERISTICS OF PHOTOMULTIPLIER TUBES.

James S. Allen. Aug. 1953. 15p. Contract W-7405-eng-36. (LA-1613)

Three short, separate papers are contained in this report. The first, "After-pulses in Photomultiplier Tubes II," is a continuation of the discussion presented in LA-1459. The paper deals in particular with photocurrent pulses measured directly at the aperture plate. An after-pulse pattern is observed without multiplication using an external amplifier. The second paper is entitled "Surface Resistivity of the Photocathode in RCA 5819 and C7164 Tubes." High currents drawn from the photocathode result in an apparent drop in sensitivity with time. This paper demonstrates that the effect is associated largely with high resistivity of the photocathode. The third paper discusses "Logarithmic Response of Photomultiplier Tubes." It is possible to obtain a logarithmic response from the multiplier structure by proper adjustment of voltages and currents. Specific examples are given. (auth)

3778

Electron Tube Research Lab., Inst. of Tech., Univ of Minn. STUDY OF THE CAUSE AND EFFECT OF FLICKER NOISE IN VACUUM TUBES. QUARTERLY REPORT NO. 1 [FOR] SEPTEMBER 15, 1953 TO DECEMBER 15, 1953. A. van der Ziel. 39p. Contract DA 36-039 sc-56683. (NP-5149)

3779

Evans Signal Lab., Signal Corps Engineering Labs. RADIOACTIVE BATTERY. Richard R. Annis. Aug. 6, 1952. 39p. (SCEL-M-1456; ATI-168672; R-7081)

3780

ISOTOPE CAPSULE FOR PNEUMATICALLY OPERATED CALIBRATION FACILITIES. Basil Markow and William Gallas (Signal Corps Engineering Labs., Fort Monmouth, N. J.). *Nucleonics* 12, No. 5, 60(1954) May.

A capsule incorporating a high-pressure seal for containing Co^{60} , or other isotopes, in a pneumatically operated calibration system is described. (C.H.)

3781

A DEVICE FOR DETERMINING RELATIVE STOPPING POWERS FOR NATURAL ALPHA PARTICLES. R. Hobart Ellis, Jr. (Columbia Univ., New York). *Rev. Sci. Instr.* 25, 336-40(1954) Apr.

A device is described by which the stopping power for Po α particles of thin solid or liquid films can be compared with that of gases. An optical system measures film thickness, and the relative stopping power is inferred from the decrease of range which results when a thin film is inserted across a beam of α particles. The device has been used with polystyrene and acetylene, and a relative stopping power of 0.99 ± 0.02 is observed. (auth)

ISOTOPES

3782

PUNCHED CARD SYSTEM FOR RADIOISOTOPES. H. R. Lukens, Jr., E. E. Anderson, and L. J. Beaufait, Jr. (Tracerlab, Inc., Richmond, Calif.). *Anal. Chem.* 26, 651-2(1954) Apr.

A simplified punched-card system for radioisotopes is presented. The system has been found to eliminate tedious searching of the tables in order to identify an isotope on the basis of its radiation characteristics and half life. (auth)

3783

ADDITIONAL PROPERTIES OF ISOTOPES OF ELEMENTS 99 AND 100. P. R. Fields, M. H. Studier, J. F. Mech, H.

Diamond, A. M. Friedman, L. B. Magnusson, and J. R. Huizenga (Argonne National Lab., Lemont, Illinois). *Phys. Rev.* 94, 209-10(1954) Apr. 1.

The nuclear properties of elements 99 and 100 isotopes in the reaction $99^{253}(\text{n},\gamma)99^{254}\beta^-100^{254}$ have been investigated after an irradiation in the MTR. (K.S.)

3784

EVIDENCE FOR Si^{32} , A LONG-LIVED BETA EMITTER. Anthony Turkevich and Arthur Samuels (Univ. of Chicago, Illinois). *Phys. Rev.* 94, 364(1954) Apr. 15.

Neutron-irradiated quartz has been found to contain 14.3-day P^{32} more than two years after the end of irradiation. This is evidence for a long-lived Si^{32} formed from stable Si^{30} by the capture of two neutrons. The ratio of half life of Si^{32} , in years, to neutron capture cross section of Si^{31} , in barns is 600. (auth)

3785

PILE PRODUCTION OF RADIOISOTOPES BY THRESHOLD REACTIONS. D. J. Hughes (Clarendon Lab., Oxford, England). *Nature* 173, 396(1954) Feb. 27.

Approximate yields for threshold reactions in the reactor are predicted by comparing the threshold reaction cross section for fission neutrons with the integral of the fission spectrum above an effective energy, which is a few Mev higher than the threshold energy for the reaction. For the reaction $\text{Fe}^{54}(\text{n},\text{p})\text{Mn}^{54}$, the threshold energy is given by the mass difference $\text{Mn}^{54}-\text{Fe}^{54}$ (0.71 Mev) minus the n-p mass difference (0.78 Mev). The integral of the fission spectrum for this reaction is then found to be 4.2 Mev. The cross section is 9.5 mb ($\text{A}^{2/3}=13.5$). (J.A.G.)

ISOTOPE SEPARATION

3786

Columbia Univ.

SEPARATION OF ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1 1952 TO JULY 1, 1953. William P. Senett, Fred Gollob, Irving F. Stacy, Gilbert Panson, Russell W. Pierce, Ivan Chasalow, Henry H. Kramer, Floyd Gould, and T. I. Taylor. July 1, 1953. 187p. Includes reprint: Exceptionally Stable Regulated Power Supply For Electrometer Tubes. William P. Senett and Russell W. Pierce. *Rev. Sci. Instr.* 23, 534-7(1952). Contract AT(30-1)-755. (NYO-6239; CU-4-53-AT(30-1)-755-Chem.)

Separate abstracts have been prepared on six parts of this report. (For previous report in series see NYO-625.) (J.S.R.)

3787

Columbia Univ.

CHEMICAL EXCHANGE EFFECTS IN THERMAL DIFFUSION COLUMNS. William P. Senett, Ivan Chasalow, and T. I. Taylor. Sect. 1 of SEPARATION OF ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1, 1952 TO JULY 1, 1953. July 1, 1953. 33p. Contract AT(30-1)-755. (NYO-6239(Sect. 1); CU-4-53-AT(30-1)-755-Chem.)

The design, construction, and operation of a glass column for separation in the NO- NO_2 system are described. Separation data are given. An all-metal column with removable lines was designed and constructed for isotope separation in the CO- CO_2 system. The use of Cu for the practical conversion of NO_2 to NO was studied. A method based on the thermal conductivity of the gases was developed for the analysis of mixtures of NO and NO_2 . A laboratory method for the efficient conversion of N^{15}H_3 to N^{15}O_2 is presented. (J.S.R.)

3788

Columbia Univ.

KINETICS AND CATALYSIS OF THE ISOTOPIC EXCHANGE OF C^{13} BETWEEN CO AND CO_2 . Fred Gollob, William P. Senett, and T. I. Taylor. Sect.3 of SEPARATION OF

ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1, 1952 TO JULY 1, 1953. July 1, 1953. 52p. Contract AT(30-1)-755. (NYO-6239(Sect.3); CU-4-53-AT(30-1)-755-Chem.)

The use of the exchange reaction $C^{18}O + C^{12}O_2 \rightleftharpoons C^{12}O + C^{18}O_2$ for isotope separation in thermal diffusion columns requires a catalyst which does not catalyze the disproportionation reaction of $CO: 2CO \rightleftharpoons C + CO_2$. A survey of a number of catalysts was made to determine their general behavior. Activated Fe is probably the most suitable catalyst because it has a high rate of exchange at a comparatively low temperature and is not sensitive to poisoning on exposure to air. (J.S.R.)

3789

Columbia Univ.

KINETICS OF THE EXCHANGE OF DEUTERIUM BETWEEN ACETYLENE AND WATER. Irving F. Stacy and T. I. Taylor. Sect.4 of SEPARATION OF ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1, 1952 TO JULY 1, 1953. July 1, 1953. 30p. Contract AT(30-1)-755. (NYO-6239(Sect.4); CU-4-53-AT(30-1)-755-Chem.)

The kinetics of the exchange of D between acetylene and water were studied. The exchange is first order with respect to hydroxyl ion concentration and first order with respect to acetylene concentration. This indicates that the rate-determining step is $C_2H_2 + OH^- \rightleftharpoons C_2H^- + H_2O$. This step is followed by the more rapid reaction $C_2H^- + HDO \rightleftharpoons C_2HD + OH^-$, resulting in the exchange. The deuterium is not involved in the rate-determining step. The equilibrium constant was calculated to be 0.61 and 0.62, confirming the value 0.60 found by earlier workers. (J.S.R.)

3790

Columbia Univ.

BINARY DIFFUSION OF SIMILAR OR ISOTOPIC MOLECULES IN THREE COMPONENT SYSTEMS. William P. Senett, Fred Gollob, and T. I. Taylor. Sect.5 of SEPARATION OF ISOTOPES. ANNUAL PROGRESS REPORT FOR JULY 1, 1952 TO JULY 1, 1953. July 1, 1953. 17p. Contract AT(30-1)-755. (NYO-6239(Sect.5); CU-4-53-AT(30-1)-755-Chem.)

The relative half lives of diffusive mixing due to isotopic gradients were studied for ternary systems. Equations were derived for the calculation of the half lives in a ternary system. The diffusion of N_2 and A into He and Kr were studied to test the equations derived. A comparison between the experimental and theoretical values showed agreement within the precision of the equipment used. (J.S.R.)

3791

A NEW METHOD FOR THE SEPARATION OF ISOTOPES IN THE TRANSITION REGION BETWEEN KNUDSEN AND POISEUILLE FLOW. H. D. Beckey and W. E. Groth. Translated by A. S. Berman from *Z. Naturforsch.* 7a, 474-80(1952). 18p. (AEC-tr-1884)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 6-5638.

3792

THE ELECTROMAGNETIC SEPARATION OF STABLE ISOTOPES. THE AMSTERDAM ISOTOPE SEPARATOR. J. Kistemaker, C. J. Zilverschoon, and J. Schutten (Lab. voor Massaspectrografie, Amsterdam). *Ned. Tijdschr. Natuurk.* 20, 5-11(1954) Jan. (In Dutch)

The mass spectrograph used in the Amsterdam mass-spectroscopy laboratory for the separation of stable isotopes is described in detail. (J.S.R.)

MASS SPECTROGRAPHY

3793

Jet Propulsion Lab., Calif. Inst. of Tech.

OPERATIONAL CHARACTERISTICS OF A RADIO-FRE-

QUENCY MASS SPECTROMETER. Ralph B. Bowersox. Jan. 29, 1954. 19p. Contract NOa(s)-53729. (JPL-25-3)

An r-f mass spectrometer is described which produces the mass spectrum from 12 to 80 amu in a sweep whose duration is 0.2 sec. The response of the spectrometer is reasonably linear with sample pressure, and peaks 1 mass unit apart may be resolved. However, the signal-to-noise ratio is no better than 20 to 1 at this sweep speed, and the spectrometer response vanishes for the low mass numbers. (auth)

3794

Jet Propulsion Lab., Calif. Inst. of Tech.

RADIO-FREQUENCY MASS SPECTROMETER FOR USE IN ANALYSIS OF GAS MIXTURES. PROGRESS REPORT. Bertram Keilin. Mar. 4, 1952. 32p. Contract Noa(s)-52-455-c. (JPL-PR-24-3; U-22663)

3795

A RECORDER FOR THE MASS SPECTROMETER WITH SHORT RESPONSE TIME. (Un Enregistreur de Spectrometre de Masse A Court Temps de Response). Ruth Valentin and Georges Philbert. Translated from *J. phys. radium* 13, 247-8(1952) 3p. (AEC-tr-1888)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 6-4567.

3796

SECOND-ORDER FOCUSING OF THE MAGNETIC SECTOR FIELD. (Die Fokussierung Zweiter Ordnung Des Magnetischen Sektorfeldes). J. Geerk and C. Heinz. Translated from *Z. Physik* 133, 513-23(1952). 21p. (AEC-tr-1890)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-1176.

MATHEMATICS

3797

Los Alamos Scientific Lab.

LOS ALAMOS CODING SYSTEM AND ASSEMBLY PROGRAM FOR THE IBM 701. PART 1. Dora W. Sweeney. LOS ALAMOS DEBUGGING PROGRAMS AND TECHNIQUES AS USED ON THE IBM 701. PART 2. Edward A. Voorhees, Jr. [1953?]. 9p. Contract [W-7405-eng-36]. (AECU-2854)

Two short, separate papers are contained in this report. The first, entitled "Los Alamos Coding System and Assembly Program for the IBM 701", describes the regional programming coding system which has been found to be most easily usable and virtually fool-proof. The second paper, entitled "Los Alamos Debugging Programs and Techniques Used on the IBM 701", discusses memory print-out and tracing, and programs used for debugging programs coded in machine language. (C.H.)

3798

Los Alamos Scientific Lab.

A NECESSARY AND SUFFICIENT CONDITION FOR UNIFORM CONVERGENCE ON A COMPACT SPACE. John Holladay and Andrew Sobczyk. [1953?]. 5p. Contract [W-7405-eng-36]. (AECU-2862)

3799

Electronics Research Labs., Columbia Univ. Engineering Center

A MATHEMATICAL TECHNIQUE FOR THE ANALYSIS OF LINEAR SYSTEMS. John R. Ragazzini and Arthur R. Bergen. Mar. 15, 1954. 26p. Contract AF-18(600)-677. (CU-5-54-AF-677-EE; T-4/8)

It is shown that the z-transformation developed originally for the analysis and synthesis of sampled-data systems is applicable to numerical solutions of continuous linear systems. A model of the continuous linear system is devised in which sampling is introduced at some convenient point. The sampled time function is then reconstructed into a polygonal approximation by means of a holding operator, and the output of the system is readily computed as a train of pulses

giving the values of the output at sampling instants. Analytic and arbitrary inputs can be handled by this model. The errors in the output which result by making computations on the sampled model rather than the actual system are obtainable by the application of a procedure quite similar to that of the main computation. An illustrative example using feedback is given, where it is shown that the theoretical predictions concerning error produced by the model are within very close tolerances to the actual error. The system of analysis described is particularly useful to engineers because the procedures are simple, are related to the physical problem, and can be applied by use of z-transform tables. (auth)

3800

RENORMALIZATION. P. T. Matthews (Univ. of Birmingham, England), and Abdus Salam (Government College, Lahore, Pakistan). *Phys. Rev.* **94**, 185-91(1954) Apr. 1.

A theoretical justification for the infinite subtractions, which have to be made in the renormalization of the S matrix, is given along the lines suggested by Gupta and developed by Takeda. It is shown that this is equivalent to working with the renormalized field variables of Dyson, and that the method deals very simply with overlapping divergences and the "wave function" renormalization associated with external lines. It also gives directly Ward's identities and brings out their essential dependence on gauge invariance. The method is applied to free and bound electrons in electrodynamics and all renormalizable meson theories. In the later sections the new method is related to the original method of Dyson; the Bethe-Salpeter equation is renormalized and closed forms are derived for the renormalization constants. (auth)

3801

QUANTIZED SPACE-TIME. Emil J. Hellund and Katsumi Tanaka (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **94**, 192-5(1954) Apr. 1.

The operators and commutators of the space-time coordinates and momenta in quantized space-time are formulated. Then the eigenfunctions and eigenvalues of the space-time operators are found. Finally, the time spectrum of the plane-wave solution of the Dirac equation is determined, and a convergent perturbation analysis is proposed. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

3802

Radiation Physics Lab., National Bureau of Standards
IONIZATION CHAMBER RESPONSE AS A FUNCTION OF WALL MATERIAL. FIFTH AND SIXTH QUARTERLY PROGRESS REPORTS COVERING THE PERIOD FROM JULY 1, 1953 THROUGH DECEMBER 31, 1953. Frank H. Attix. 13p. (NBS-3238)

Measurements of ionization per cc vs. air-gap width were made with an extrapolation chamber, using walls of C, Al, Cu, Sn and Pb. The gamma-ray source was Co^{60} , 1250 kev. As previously reported, the graphite-walled extrapolation chamber produced several percent more ionization per cc than a standard free-air chamber, when exposed to heavily filtered x rays of 150 to 250 kv. (For preceding period see NBS-2771.) (auth)

3803

National Bureau of Standards
CALIBRATION OF SIX AN/PDR-32, TYPE A RADIAC SETS CONSTRUCTED BY ANTON LABORATORIES, INC. F. H. Day. Apr. 26, 1954. 17p. (NBS-3265)

3804

National Bureau of Standards
CALIBRATION OF SIX AN/PDR-40(XN) RADIAC SETS CONSTRUCTED BY ADMIRAL CORPORATION, CHICAGO, ILLINOIS. F. H. Day. Apr. 26, 1954. 19p. (NBS-3269)

3805

National Bureau of Standards

LIFE TESTS AND CALIBRATION OF SURVEY METER EP-291, SERIAL NO. 2, PRODUCED BY ELECTRONIC PRODUCTS COMPANY. MT. VERNON, NEW YORK F. H. Day. Apr. 28, 1954. 14p. (NBS-3272)

3806

Evans Signal Lab., Signal Corps Engineering Labs.
RADIOLOGICAL CONTAMINATION MONITORS. Robert H. Sugarman and Felix J. Lavicka. Oct. 12, 1953. 22p. (SCEL-M-1539; [AD-20695])

Two portable survey instruments designed for measuring the beta contamination of an object or surface in the presence of a gamma-radiation background have been constructed and are ready for field use. Both instruments use a single ionization chamber with a sturdy window measuring approximately 10 in. \times 10 in. and capable of passing soft beta radiation. The gamma background intensity can be measured before being zeroed out electronically. Model A, which can also be used as a "hot-spot" indicator, has a full-scale calibration of 10 microcuries Sr^{90} equivalent or 30 mr/hr Co equivalent. Range multipliers of X1, X10, and X500 are used. Model B, which has a unique self-contained beta shield, has full scale calibration from 0.3 microcuries to 3 millicuries for beta intensities or from 0.5 mr/hr to 5 r/hr for gamma. (auth)

3807

WHICH I^{131} COUNTING SYSTEM IS BEST FOR LABORATORY USE? John H. Weisburger and Harry J. Lipner (National Institutes of Health, Bethesda, Md.). *Nucleonics* **12**, No. 5, 21-3(1954) May.

The relative efficiencies of various counting systems for use with I^{131} were investigated. Windowless counters were found to have efficiencies equal to a well-type scintillation counter. However, the simpler and more convenient sample preparation favor the scintillation counter for routine laboratory use. Where economic factors play a role in the selection of counting systems, a simple G-M tube used under appropriate conditions ensures satisfactory results. (C.H.)

3808

PHOTOGRAPHIC DETECTION AND DOSIMETRY OF BETA RAYS. Robert A. Dudley (Mass. Inst. of Technology, Cambridge). *Nucleonics* **12**, No. 5, 24-31(1954) May.

Applications of photographic film in the measurement of β -radiation dose are reviewed. The effects of angle of incidence, energy spectrum, development, and film properties on the dosimetric properties of five films were investigated, and data are summarized. It was concluded that over-all reproducibility of β -ray film measurements is good when calibration with standard sources is carried out. (C.H.)

3809

SCINTILLATION PROBE FOR DETERMINING RELATIVE BETA-RAY INTENSITIES. William B. Ittner, III, and Michel Ter-Pogossian (Washington Univ. Medical School, Saint Louis, Mo.). *Nucleonics* **12**, No. 5, 56-7(1954) May.

A scintillation counter is described which was designed to map the gradient of the radiation field in the vicinity of an extended, plane β source immersed in water. Design and performance data are included, and applications of the counter to biological β -ray dosimetry are discussed. (C.H.)

3810

SCINTILLATION SPECTROMETRY OF CONTINUOUS γ -AND X-RAY SPECTRA BELOW 1 Mev. K. Lidén and N. Starfelt (Univ. of Lund, Sweden). *Arkiv. Fysik* **7**, No. 5, 427-57(1954). (In English)

An analysis of the factors involved in the scintillation

spectrometer method used for quantitative evaluation of continuous γ and β ray spectra in the range 0 to 1 Mev suggested that the usefulness and accuracy of the method could be improved by special attention to long-term stability of the apparatus, the back-scattered photons from the multiplier window, the K x radiation from Pb, corrections for Compton effect, the escape of I K x rays, the electron escape fraction at low energies, and the effective photoelectric efficiency. (K.S.)

3811

AFTER-PULSE IN SCINTILLATION COUNTERS. K. P. Meyer and A. Maier (Universität Basel, Switzerland). *Helv. Phys. Acta* 27, 57-66(1954) Mar. 15. (In German)

Afterpulses arising in scintillation counters built of commonly used components are described. They may simulate delayed nuclear radiation, when using dead-time free coincidence arrangements. One source of afterpulses is the luminescence of dynode surfaces. Ag-Mg dynodes give afterpulses; Cu-Be practically none. Another source is the scintillator itself. The scintillations of anthracene and transstilbene crystals include slower components of remarkable intensity. Decay times (10^{-8} to 10^{-6} sec range) and intensities (3 to 10%) are given. These slower emissions are resolved by the multiplier into single-photon afterpulses. As expected for a liquid scintillator there are practically no afterpulses in a terphenyl solution. All afterpulses reported are single-photon pulses. Using Schaettli-multipliers no afterpulses arising from more than one photoelectron were observed. (auth)

3812

INTRODUCTORY REMARKS ON THE DOSIMETRY OF IONIZING RADIATIONS. U. Fano (National Bureau of Standards, Washington, D.C.). *Radiation Research* 1, 3-9 (1954) Feb.

Factors affecting physical determinations of radiation dose are reviewed, and conditions of exposure which may affect the accuracy of dosimetry are discussed. (C.H.)

3813

X-RAY DOSIMETRY: GENERAL PRINCIPLES AND EXPERIMENTAL FACTORS. Leonidas D. Marinelli (Argonne National Lab., Lemont, Ill.) *Radiation Research* 1, 23-33(1954) Feb.

Factors affecting x-ray dosimetry are reviewed, and methods for measuring x radiation are discussed. (C.H.)

3814

THE MEASUREMENT OF HIGH-ENERGY RADIATION INTENSITY. D. V. Cormack and H. E. Johns (Univ. of Saskatchewan and Saskatchewan Cancer Commission, Canada). *Radiation Research* 1, 133-57(1954) Apr.

The effects of the atomic number of materials used in wall construction on ionization chamber performance were investigated. The contribution of the back wall to ionization within the chamber was found to be small for materials of low atomic number, but to amount to as much as 40% for high atomic numbers. Recommendations are made concerning materials for wall construction. (C.H.)

3815

TECHNIQUES FOR PROCESSING THICK NUCLEAR EMULSIONS. Bertram Stiller, Maurice M. Shapiro, and Francis W. O'Dell. (Naval Research Lab., Washington, D.C.). *Rev. Sci. Instr.* 25, 340-8(1954) Apr.

Techniques are described for the "eradication" and processing of thick electron-sensitive nuclear emulsions and for handling "pellicles." Emulsions of 400 and 600 μ , eradicated by a method which preserves their sensitivity to minimum-ionization particles, exhibit marked reduction in track distortion, as well as background. A modified procedure for uniform development of thick

emulsions by the temperature-cycling method gives a favorable ratio of grain density to background. Counter-measures against stripping of thick emulsions from their glass base have proved efficacious over a 3-year period. A stack of emulsions without glass support ("pellicles") provides a large sensitive volume in which tracks can be readily followed from one layer to the next. The lateral swelling ($\sim 25\%$ during processing, which discouraged the application of this technique, was overcome by the authors (*Phys. Rev.* 85, 712 (1952)) in 1951. They evolved a successful method for mounting thick, stripped emulsions onto glass after exposure, but prior to processing, so that the pellicles can be developed as ordinary plates. Since then, additional experience has been gained in the application of pellicle stacks to high-energy physics. The procedures lead to emulsions free from lateral swelling, free from blistering, and characterized by a level of distortion sufficiently low to permit multiple scattering measurement even on fairly "stiff" tracks. The advantages and limitations of this technique, its possible applications, details of the mounting procedure, and methods of following tracks from layer to layer are discussed. (auth)

3816

INFLUENCE OF THE VARIATION OF THE CONDITIONS IN A CLOUD CHAMBER DURING THE SENSITIVE TIME ON THE ACCURACY OF CROSS-SECTION MEASUREMENTS. Sam Barile and Raynor Webeler (Lewis Flight Propulsion Lab., Cleveland, Ohio). *Rev. Sci. Instr.* 25, 389(1954) Apr.

The quality of particle tracks in a low-pressure cloud chamber was observed during various stages of piston expansion in order to determine the feasibility of applying such a chamber to cross section measurements. It was found that changes in the density of constituent gases due to expansion and vaporization were small enough so as to introduce errors of only 1 or 2% in range and cross section measurements. (K.S.)

3817

INTENSITY CORRECTIONS FOR IODINE X-RAYS ESCAPING FROM SODIUM IODIDE SCINTILLATION CRYSTALS. Peter Axel (Univ. of Illinois, Urbana). *Rev. Sci. Instr.* 25, 391(1954) Apr.

The measurement of γ -ray intensities by using a NaI scintillation crystal is simplified if the probability that an incident γ ray will transfer its entire energy to the crystal is known. Events corresponding to complete energy transfer form the distinctive photopeak in the amplitude distribution of voltage pulses at the output of the photomultiplier. When a low-energy γ ray interacts in a crystal by means of the photoelectric effect, the event contributes to the photopeak unless an I x ray is formed and escapes from the crystal. If 28.4-keV I K x rays leave the crystal, an "escape peak" is formed at an energy 28.4-keV below the photopeak. The ratio of the integrated intensity of the escape peak to that of the photopeak depends on the energy of the radiation, the dimensions of the crystal, and the geometry of the experiment. Calculations of this escape effect have been made as a function of energy and experimental geometry; these calculations are applicable to crystals that are sufficiently large. The results are given in formulas and in a table. (auth)

3818

THE TEMPERATURE DEPENDENCE OF THE CHARACTERISTICS OF THE GAS-FILLED GEIGER-MUELLER TUBES. Hans Joseph Mader (Technische Hochschule, Munich, Germany). *Z. Physik* 137, 216-27(1954). (In German)

Measurement of the temperature dependence of the characteristics of the self-quenching tube—that is, a tube with

the addition of the gas of an organic compound to the A— shows a strong influence of the temperature on the form and position of the tube range. For each tube there appears to exist a favorable temperature at which the range of the characteristic depends least on the tube pressure. On either side of the temperature the width of the range decreases rapidly, and the increase of the characteristic becomes greater. For large deviations from the most favorable temperature the range disappears at an upper and lower limiting temperature which is a characteristic of the tube. (tr-auth)

3819

THE EFFECTS OF FAST NEUTRONS FROM A NUCLEAR DETONATION ON CHROMOSOME BREAKAGE IN *TRAD-EScantia*. J. S. Kirby-Smith, C. P. Swanson, C. W. Sheppard, and E. B. Darden, Jr. (Oak Ridge National Lab., Tennessee). *Science* 119, 42-5(1954) Jan. 1.

Data are presented from studies of the effects of fast neutrons from a nuclear detonation on chromosome breakage in *Tradescantia*. Physical dose estimates in the detonation experiment were calibrated with cyclotron measurements. Methods of measurement are described, and the relative biological efficiency for detonation neutrons compared with fast neutrons from a cyclotron was calculated as $1 \pm 25\%$. The use of *Tradescantia* as a biological dosimeter for fast neutrons is discussed. (C.H.)

MESONS

3820

Radiation Lab., Univ. of Calif., Berkeley
MESON MASS MEASUREMENTS. PART 1. THEORY OF THE MASS RATIO METHOD. Walter H. Barkas. Sept. 16, 1953. 39p. Contract W-7405-eng-48. (UCRL-2327)

The theory of particle mass-ratio measurement is treated. It applies particularly to the method in which measurements are made of particle ranges and momenta. A certain statistical variable, Rp^{-q} , is introduced. It is the quotient of the particle range and the q th power of its momentum, where q is that power of the momentum which makes the expectation value of the quotient independent of the particle velocity, in the velocity interval selected for the measurements. The expectation value of Rp^{-q} depends on the particle mass. The ratio of such expectation values for different particles at equal velocities provides a measure of the ratio of particle masses which does not depend on the exponent q , on the stopping material, or on the absolute value of the magnetic field employed to measure the momenta. The theory of particle orbits in the non-uniform cyclotron field is worked out to provide the formulas from which momenta may be calculated, and to obtain the momentum distribution function appropriate to the finite target and detector dimensions. The energy loss processes in the nuclear track emulsion, which is used as a detector and stopping material are studied, and the range-momentum exponent, q , found. A number of range-straggling effects are evaluated. The theoretical distribution function of Rp^{-q} is studied, and the first three moments of the distribution calculated explicitly. The distribution is found to be essentially Gaussian. From the theory of the distribution of Rp^{-q} , the best estimate and the statistical uncertainty of the mass ratio (e.g., of meson to proton) are evaluated. The measurement of the absolute decay momentum of the muon is also considered, and formulas for the best estimates of the absolute pion and muon masses derived. These contain only the pion to muon mass ratio and the absolute decay momentum. (auth)

3821

SOME OBSERVATIONS ON THE DECAY OF NEUTRAL V-PARTICLES IN PHOTOGRAPHIC EMULSIONS. M.

Yasin (Univ. of Bristol, England). *Phil. Mag.* (7) 45, 413-17(1954) Apr.

In an examination of two-particle events recorded in photographic emulsions, four examples have been observed of a type similar to the decay of Λ^0 particles in Wilson chambers. In three of them, the measured energy release in the decay is ~ 40 Mev; in the fourth example it is ~ 70 Mev. An event has also been observed which appears to correspond to the decay in flight of a θ^0 particle, emitted from a nuclear disintegration of type $10 + 7p$. One of the secondary particles arising from the decay is a negative π meson. The measured Q value is 202 ± 11 Mev. (auth)

3822

OBSERVATIONS ON CHARGED HYPERONS IN PHOTOGRAPHIC EMULSIONS. M. W. Friedlander (Univ. of Bristol, England). *Phil. Mag.* (7) 45, 418-23(1954) Apr.

Two examples of charged hyperons have been observed in photographic emulsions. One decays in flight, and its transformation may be represented $Y^\pm \rightarrow L^\pm + N^0 + Q$, the release of energy, Q , being consistent with values obtained in other laboratories. In the other example, the secondary is a fast proton. This event may represent either the decay of a new type of hyperon or the nuclear capture of a negative hyperon. (auth)

3823

EVIDENCE FOR NUCLEAR INTERACTION OF A CHARGED HYPERON ARRESTED IN PHOTOGRAPHIC EMULSION. R. H. W. Johnston and C. O'Ceallaigh (Dublin Inst. for Advanced Studies, Ireland). *Phil. Mag.* (7) 45, 424-9(1954) Apr.

An event which is interpreted as a nuclear interaction of a charged hyperon has been observed in a photographic emulsion. The appearance of the interaction is that of a typical σ star but is caused by a particle of protonic mass. Estimates of mass by two independent techniques are in agreement with each other and are consistent with those of charged hyperons reported by other workers. (auth)

3824

PRODUCTION OF HEAVY UNSTABLE PARTICLES BY NEGATIVE PIONS. W. B. Fowler, R. P. Shutt, A. M. Thorndike, and W. L. Whittemore (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* 93, 861-7(1954) Feb. 15.

In addition to two previously discussed cloud-chamber examples of V-particle production by 1.5-Bev π^- mesons from the Cosmotron, four further examples are discussed here. In two of the new examples a $\Lambda^0(V_1^0)$ and a $\phi^0(V_1^0)$ are seen to decay in a geometry indicating that they were produced together in a $\pi^- - p$ collision. A third example is best interpreted as production of a $\Lambda^-(V_1^-)$ together with a $K^+(V_2^+)$ by π^- colliding with a proton. A fourth example shows a probable Λ^- decaying into a π^- and a neutron with a Q value of about 130 Mev. A cross section of ~ 1 mb for V-particle production is inferred from the number of $\pi^- - p$ collisions observed. (auth)

3825

PRODUCTION OF K MESONS. U. Haber-Schaim, (Weizmann Inst. of Science, Rehovoth, Israel) and Y. Yeivin and G. Yekutieli, (Israel Atomic Energy Commission, Tel Aviv). *Phys. Rev.* 94, 184-5(1954) Apr. 1. (cf. NSA 6-6135.)

Calculations reported in an earlier paper are extended to lower energies using Fermi's explicit statistical method. A few pertinent details of the calculation are given, and the results compared with the observations of the Bristol group. (auth)

3826

KINEMATICS OF Λ^0 PRODUCTION. George T. Reynolds

and S. B. Treiman (Princeton Univ., New Jersey). *Phys. Rev.* **94**, 207-8(1954) Apr. 1.

Cloud chamber observations of Λ^0 production show that at least 10% of the observed particles have energies below 70 Mev. The kinematics of several possible interactions which will produce such a result are discussed. Curves are plotted for four possible cases of isotropic Λ^0 production. For anisotropy of the form $u(\cos \theta^*) = \frac{1}{2}(n + 1)|\cos^n \theta^*|$, the observed results require a value of $n > 6$. (K.S.)

3827

A CONNECTION BETWEEN PION PHOTOPRODUCTION AND SCATTERING PHASE SHIFTS. Marc Ross (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **94**, 454-60 (1954) Apr. 15.

It is found in a rough approximation that meson photoproduction matrix elements can be expressed in terms of meson-nucleon scattering phase shifts and some energy-independent parameters, for photons in the laboratory of 200 to 500 Mev. The parameters are fitted to experiment in the lower portion of this energy region. It is then found that the higher-energy photoproduction data are consistent only with a $p_{3/2}$, isotopic spin $3/4$, phase shift which passes through 90° at a scattering energy of about 180 Mev. It is indicated that the s-wave phase shifts remain small. (auth)

3828

MESIC ATOMS. M. I. Podgoretskii. *Uspekhi Fiz. Nauk* **51**, 253-70(1953) Oct. (In Russian)

A general review is given of the present knowledge concerning mesic atoms of any type, but with emphasis on μ and π mesic atoms. 49 references. (J.S.R.)

3829

MULTIPLE PRODUCTION OF MESONS BY PSEUDOSCALAR COUPLING. Walter Thirring (Univ. of Bern, Switzerland). *Helv. Phys. Acta* **27**, 45-56(1954) Mar. 15. (In German)

Meson production by nucleon collision with pseudoscalar and pseudovectorial coupling was calculated with a classical treatment of the nucleon. It was shown that, with pseudoscalar coupling, pair production of mesons must compete with single production at the present artificially obtained energies. (tr-auth)

MICROWAVES

3830

Columbia Radiation Lab., Columbia Univ. QUARTERLY PROGRESS REPORT [NO. 5]. Jan. 30, 1954. 26p. Contract DA-36-039-SC-42519, Report No. 4. (CU-1-54-SC-42519-Phys.)

Additional work has been done on high-power magnetrons operating at a wavelength of 6 mm. Previous work has shown a high operating efficiency and maximum power output for these tubes. Work directed to the development of improved windows and cathodes for the tubes is reported. The inauguration of a program directed toward a study of harmonic generation in magnetrons is reported. The program has the twofold objective of clarifying certain aspects of magnetron operation and of exploring the possibilities of developing magnetrons with useful harmonic output. Additional magnetrons to operate at a low magnetic field and a wavelength of 2.6 mm have been constructed as have tunable magnetrons at a longer wavelength. It is clear that considerable technical development is required to produce satisfactory magnetrons in either of these categories. The observation of certain transitions among the components of the metastable state of H_2 is reported which permit a preliminary estimate of the hfs separation of that state to be made. The high resolution microwave bridge spectrometer has allowed a number of measurements of the very small magnetic hyperfine interactions in

$^1\Sigma$ molecules. Improvement of the spectrometer for free radicals has resulted in detection of a number of new lines of OH and its isotopic species. All experimental information needed for understanding the OH hfs seems now to have been obtained. (auth)

NEUTRONS

3831

MEASUREMENT OF THE ABSOLUTE INTENSITY OF A SOURCE OF NEUTRONS. E. Rodríguez Mayquez and C. Sánchez del Río (Junta de Energía Nuclear, Madrid, Spain). *Anales real soc. españ. fis. y quim. (Madrid)* Ser. A, **50**, 27-32(1954) Jan.-Feb. (In Spanish)

The absolute intensity of a Ra-Be neutron source has been measured. The source contains 500 milligrams of radium plus 5 grams beryllium and produces $(5.85 \pm 0.76) \times 10^6$ neutrons/sec. The experimental procedure is described, and the result discussed and compared with those of similar determinations. (auth)

3832

GRAPHS FOR THE SIMPLIFICATION OF THE CALCULATIONS RELATING TO THE ENERGY OF NEUTRONS IN THE REACTIONS (d,n). J. Catalá, J. Aguilar, and F. Senent. *Anales real españ. fis. y quim. (Madrid)* Ser. A **50**, 33-40(1954) Jan.-Feb. (In Spanish)

Three graphs are presented to simplify the calculations to obtain the energy of particles entering nuclear emulsions from the microscopic measurements of the neutron track length. The working method is described, and it is found that the saving in time results in no appreciable loss in accuracy. (auth)

3833

TIME DEPENDENCE OF BORON ABSORPTION COEFFICIENT FOR NEUTRONS SLOWED DOWN IN WATER AT ROOM TEMPERATURE. G. von Dardel (AB Atomenergi, Stockholm, Sweden). *Arkiv Fysik* **7**, 357-73(1954). (In English)

The lifetime of neutrons in a moderator may be divided into three periods: the initial period during which the neutrons are slowed down from their initial energy to the adsorption limit, the transition period in which the neutrons approach thermal equilibrium with the moderator, and the thermal period which extends until the neutrons have disappeared. The time scale for the slowing down process and the approach to thermal equilibrium was studied. The experimental apparatus and some of the measurements are described for the first and second periods. (J.S.R.)

3834

ON THE SCATTERING OF SLOW NEUTRONS BY CRYSTALS NEAR THE BRAGG ANGLES. Alf Sjölander (Univ. of Uppsala, Sweden). *Arkiv Fysik* **7**, 375-90(1954). (In English)

Formulas for the diffuse temperature scattering of neutrons by an isotropic cubic crystal are derived, which are valid when the Laue interference conditions are approximately fulfilled. The singularities of the scattering cross section are studied for anisotropic cubic crystals, and relations between the singular directions and the elastic constants of the crystal are given. Finally, some general results about the intensity of the scattering are derived. (auth)

3835

NEUTRON POLARIZATION. C. P. Stanford, T. E. Stephenson, L. W. Cochran, and S. Bernstein (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **94**, 374-81(1954) Apr. 15.

The neutron polarization cross section of Fe has been measured as a function of energy from 0.7 to 3.3A by two methods: using the single-transmission effect in a block of

polycrystalline Fe at energies selected by a quartz crystal monochromator; and using a single crystal of magnetized magnetite to analyze the beam emerging from the Fe polarizer, the magnetite crystal itself serving as monochromator. The measured values are compared with those of other observers and the theoretically expected values. These are found to agree fairly well within the limits of accuracy of the measurements and existing knowledge of the wave function of the Fe 3d shell. The two techniques were used also to determine the average polarization (32%) as seen by a $1/\nu$ detector in a beam of reactor neutrons emerging from a 4-cm-thick polarizing block of Fe. Problems and techniques associated with the measurement of the average polarization of a continuous spectrum are discussed. A simplified experimental treatment of the problem of beam "hardening" is described. A description is given of the use of the magnetic resonance method in conjunction with a single-crystal magnetite analyzer for the measurement of neutron polarization. (auth)

NUCLEAR PHYSICS

3836

Nuclear Physics Labs., Columbia Univ.

PROGRESS REPORT FOR JULY, AUGUST, SEPTEMBER 1953 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. 43p. Contract AT-30-1-GEN-72. (CU-131)

A summary of work done on the neutron capture cross sections of Cd, Sr, Ba, and Ag is presented, together with a critical evaluation of the capture- γ method for measuring these cross sections. Charge independence for nuclear forces was examined, and the presently measured case of Li was found favoring charge independence. The design of an electromagnet current regulator for reduction of long-time variations is described. An initial pulse selector circuit is presented which allows the first pulse of a positive train to appear without inversion but depresses succeeding pulses that are not more than twice the height of the original pulse. A special-purpose BF_3 counter filling station is described. The first BF_3 counter design tested with this system was a 3-cm counter having a plateau of 75 v starting at 1550 v. Methods and techniques for the fabrication of thin B and phosphor films are outlined in connection with the development of a slow-neutron scintillation counter. The counter tested was a spherical volume of terphenyl-activated polystyrene with a 6292 photomultiplier for detection of n - γ scintillations. Performance data of this configuration are given, using a Co^{60} source. Measurements of magnetic quenching of the $m = 0$ state in positronium have been initiated, and evidence is indicated for a $2430 \text{ A } n = 2 \rightarrow n = 1$ transition. A study of the $e - \nu$ angular correlation of He^6 has shown that the tensor invariant is the dominant G-T term in the β -decay interaction Hamiltonian. A survey has been made for β -active nuclei whose angular correlations are sensitive to the Fermi invariants. Final design and assembly of a pulse transformer accelerator is described. (For preceding period see CU-130.) (K.S.)

3837

Radiation Lab., Univ. of Calif., Berkeley

PHYSICS DIVISION QUARTERLY REPORT [FOR] NOVEMBER, DECEMBER 1953, JANUARY 1954. Mar. 11, 1954. 39p. (UCRL-2513)

Relative photomeson (π^+) production cross section data from H_2 and C have been obtained from experiments with the spiral-orbit spectrometer. Studies of low-energy π -meson production by 340-Mev protons on complex nuclei indicate results which would be expected from the presence of a nuclear Coulomb barrier. Deuteron production experiments by proton pickup reactions on light and heavy nuclei tend to support the idea that the surface of a nucleus may be

predominantly neutrons and that the pickup process takes place largely at the surface. A comparison study of the $p + d \rightarrow \pi^+ + \text{H}^3$ and $p + d \rightarrow \pi^0 + \text{He}^3$ reactions indicated that the ratio of differential cross sections was consistent with a value predicted by conservation of isotopic spin or charge independence. Preliminary results on the double scattering of 32-Mev protons by C are reported. Irradiation of Be by 31.5-Mev protons yields a spectrum showing groups of inelastically scattered protons, indicating that the Be^9 nucleus is left in the excited state. Data on the angular distribution of elastically scattered protons from Be^9 are also presented. Cyclotron runs of polarization in p - n - p double scattering in C and Ta show that for 17 and 25° scattering angles at 190 Mev, $e = R - L/R + L = 0$. For 35° , 35° , 245 Mev, an asymmetry of $5.2 \pm 3\%$ was observed, and at 45° , 45° , 330 Mev, asymmetries of $4.5 \pm 3.5\%$ and $10.5 \pm 3.5\%$ were observed for Ta and C, respectively. A series of experiments on n - p scattering cross sections from 6 to 180° (c.m.) show that there is a symmetry of the differential cross section curve about 90° . Modification of the 60-in. cyclotron ion source is described to enable the use of various types of ions without changing sources. (For preceding period see UCRL-2434.) (K.S.)

3838

THE GROUND STATES OF ODD-ODD NUCLEI. C. Schwartz (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **94**, 95-9(1954) Apr. 1.

Applications of techniques already developed for the study of atomic spectra to calculations on odd-odd nuclei give some particularly simple results. The spins of the ground states of nearly all odd-odd nuclei measured can be accounted for, and the validity of Nordheim's empirical rules is discussed. (auth)

3839

THE RANGES OF FRAGMENTS FROM HIGH-ENERGY FISSION OF URANIUM. E. M. Douthett and D. H. Templeton (Univ. of California, Berkeley). *Phys. Rev.* **94**, 128-37(1954) Apr. 1.

The ranges in aluminum of several fragments from the fission of U^{238} induced by 18-Mev deuterons and by 335-Mev protons have been measured by a radiochemical method. The ranges found are of the same order of magnitude as those reported for slow-neutron-induced fission. The difference in the forward and backward recoil ranges in the deuteron (18-Mev) case is consistent with the momentum corresponding to compound nucleus formation. The ranges found in the proton (high-energy) case are shorter than those of the deuteron case, the differences being greater for the lighter fragments. These differences are explained by the change in mass of the complementary fragments due to evaporation of neutrons prior to fission in the proton case, which causes the observed fragment to receive a smaller fraction of the total kinetic energy. (auth)

3840

PHOTON SPLITTING IN A NUCLEAR ELECTROSTATIC FIELD. Mark Bolsterli (Washington Univ., St. Louis, Mo.). *Phys. Rev.* **94**, 367-8(1954) Apr. 15.

The cross section for the splitting of a photon into two photons in a nuclear electrostatic field has been calculated from the vacuum polarization Hamiltonian of Euler and others to first order in $e^2/\hbar c$ for low-energy incident photons ($p < mc$). For a favorable experimental case, photons of energy 840 kev incident on Pb with antiparallel product photons each emitted at 90° relative to the incident photon, the cross section is $2.3 \times 10^{-33} \text{ cm}^2/\text{sterad}^2$. (auth)

3841

THE BINDING ENERGY OF THE ALPHA PARTICLE. A. C. Clark (Univ. of Liverpool, England). *Proc. Phys. Soc. (London)* **A67**, 323-30(1954) Apr. 1.

The method of Morpurgo is extended to deal with both central and tensor forces, each having Yukawa-type radial dependence. The method is applied to calculate the binding energy of He^4 for one set of Pease-Feshbach force parameters. It is shown that the inclusion of a second D state in the trial wave function leads to a large increase in binding energy. (auth)

3842

NEUTRON PHYSICS OF CONCERN TO THE BIOLOGIST. Burton J. Moyer (Univ. of Calif., Berkeley). Radiation Research 1, 10-22(1954) Feb.

Elementary neutron physics is reviewed, and factors affecting neutron dosimetry are discussed. (C.H.)

NUCLEAR PROPERTIES

3843

Los Alamos Scientific Lab.

THERMAL NEUTRON CAPTURE CROSS SECTIONS OF HYDROGEN, BORON, AND SILVER. F. R. Scott, D. B. Thomson, and W. Wright. [1953] 11p. Contract [W-7405-eng-36]. (AECU-2864)

A direct measurement of the n-p capture cross section was made by the determination of the mean life of thermal neutrons in a finite water geometry using a pulsed neutron source. The depth of the water was varied from 9 to 20 in., and the thermal neutron mean life was obtained for each case. A mean life of $t_{\infty} = 213 \pm 4 \mu\text{sec}$ for the thermal neutrons in an infinite water medium, a diffusion length $L = 2.85 \pm 0.05 \text{ cm}$, and a transport mean free path $\lambda = 0.525 \pm 0.010 \text{ cm}$ were calculated. The mean free life was then transformed into a thermal n-p absorption cross section of $\sigma_H = 0.323 \pm 0.008$ barns at a neutron velocity of 2200 m/sec. The thermal neutron capture cross sections of B and Ag were also determined by measuring the thermal neutron lifetime in various water concentrations of anhydrous B_2O_3 and AgCl . Values of $\sigma_B = 744 \pm 20$ barns and $\sigma_{Ag} = 58.0 \pm 2$ barns are given for their respective thermal neutron capture cross sections. (J.A.G.)

3844

THE REACTION ENERGY OF $\text{Ne}^{22}(\text{d},\text{p})\text{Ne}^{23}$ AND THE ATOMIC MASS OF Ne^{23} . Katarina Ahnlund (Nobel Inst. of Physics, Stockholm). Arkiv. Fysik 7, No. 5, 459-62(1954). (In English)

A new determination of the reaction energy of $\text{Ne}^{22}(\text{d},\text{p})\text{Ne}^{23}$ gave a value $Q = 2.968 \pm 0.008 \text{ Mev}$. From the Q value of the reaction, the atomic mass was calculated to be $\text{Ne}^{23} = 23.001763 \pm 0.000027 \text{ amu}$. (auth)

3845

AN ATOMIC MASS STUDY OF NUCLEAR SHELL STRUCTURE IN THE REGION $82 < n < 126$. Benjamin G. Hogg and Henry E. Duckworth (McMaster Univ., Hamilton, Ontario, Canada). Can. J. Phys. 32, 65-71(1954) Jan.

A number of new atomic masses are reported in the region $82 < n < 126$ and are used to study nuclear stability in this region. No stability effects associated with a particular neutron number are noticed, but rather there is a broad general increase in stability between the 82 and 126 neutron shells. (auth)

3846

ON THE DISINTEGRATION OF $_{81}\text{Ti}^{204}$. Tosiko Yuasa, Jeanne Laberrigue Frolow, and Louis Feuvrais. Compt. rend. 238, 1500-2(1954) Apr. 5. (In French)

The β^- spectrum of Ti^{204} was studied with the aid of a spectrograph with a thick magnetic lens, and the maximum energy was found to be $E_{\beta^- \text{max}} = 765 \pm 10 \text{ kev}$. The spectrum was analyzed to the straight line of Fermi corrected for the transition $\Delta J = 2$, yes, and for the screen effect. The absence of γ and internal conversion electrons does not allow a conclusion as to the complexity of the spectrum.

The Auger rays relative to K capture (capture $K/\beta^- \sim 4\%$) were also studied. (tr-auth)

3847

SPINS OF ODD-ODD NUCLEI IN THE j-j COUPLING MODEL. I. A. Hitchcock (Cavendish Lab., Cavendish Lab., Cambridge, England). Phil. Mag. (7) 45, 379-84 (1954) Apr.

An attempt is made to justify the empirical rules for the spins of odd-odd nuclei recently proposed. It is found possible to do so for certain classes of nuclei, which happen to include all those for which the experimental evidence is reliable and the rules obeyed. For one of the classes, however, it is necessary to make the approximation of assuming nuclear forces of infinite range. (auth)

3848

SPINS OF ODD-ODD NUCLEI IN THE j-j COUPLING MODEL. II. A. Hitchcock (Cavendish Lab., Cambridge England). Phil. Mag. (7) 45, 385-93(1954) Apr.

The spins of a number of odd-odd nuclei are calculated on the basis of the spin-orbit coupling model. The study is limited to light and medium nuclei for which experimental data are available. The agreement between theory and experiment is generally good. No systematic rules are proposed, and it appears that no simple ones exist, except in the cases previously treated. (auth)

3849

TOTAL CROSS SECTIONS FOR 410-Mev NEUTRONS. V. Alexander Nedzel (Univ. of Chicago). Phys. Rev. 94, 174-83(1954) Apr. 1.

Good geometry transmission measurements were conducted in the high-energy neutron beam of the University of Chicago synchrocyclotron. Total cross sections of fourteen elements, measured at an effective neutron energy of 410 Mev, were determined as follows (units of millibarns):

Hydrogen	33.7 ± 1.3	Chlorine	742 ± 10
Deuterium	62.0 ± 4	Iron	1073 ± 12
Beryllium	231 ± 4	Copper	1187 ± 14
Carbon	297 ± 3	Cadmium	1848 ± 21
Oxygen	378 ± 5	Lead	2890 ± 30
Aluminum	587 ± 8	Thorium	3210 ± 40
Sulfur	672 ± 9	Uranium	3230 ± 40

It was found that the following two-parameter empirical formula was consistent with the measured cross section to within the accuracy of their determination:

$$\sigma = 2\pi R^2 [1 - \exp(-KR)],$$

where $R = r_0 A^{1/2}$, and the two constants were chosen as $r_0 = 1.20 \times 10^{-13} \text{ cm}$, and $K = 0.360 \times 10^{13} \text{ cm}^{-1}$. The sole exception was hydrogen, for which the prediction by the formula was 5 percent below the measured value. The results are compared with neutron cross sections at lower energies, with proton cross sections at the same energy, and are discussed from the point of view of the transparent optical model. (auth)

3850

LOW-LYING STATES OF Be^8 . E. W. Titterton (Australian National Univ., Canberra). Phys. Rev. 94, 206-7(1954) Apr. 1.

It is suggested that weakly excited states of Be^8 may be obscured in $\text{B}^{11}(\text{p},\alpha)\text{Be}^8$ and $\text{B}^{10}(\text{d},\alpha)\text{Be}^8$ reactions because of the continuum of α particles present from the breakup of the Be^8 nucleus itself. Several other reactions are discussed which indicate the existence of even states at 4.05, 5.3, and 7.5 Mev and which provide evidence against a 4.9-Mev γ -emitting state. (K.S.)

3851

PARAMAGNETIC RESONANCE SPECTRA OF SOME FERRIC ALUMS, AND THE NUCLEAR MAGNETIC MOMENT OF ^{57}Fe . B. Bleaney and R. S. Trenam (Univ. of Oxford, England). *Proc. Roy. Soc. (London)* **A223**, 1-14(1954) Apr.

The paramagnetic resonance spectra of ferric rubidium sulphate and ferric potassium selenate alums (diluted with the corresponding aluminium alums) have been analyzed in detail. It is found that the splitting of the ^6S state of the ferric ion can be explained in terms of a spin Hamiltonian containing trigonal terms of the second and fourth degree and a cubic term. The measurements show also that the axes of the cubic crystalline field are rotated through a small angle from those of the crystal unit cell, as expected from x-ray analysis of the structure (Lipson 1935). No hyperfine structure due to Fe^{57} could be resolved in a sample containing 40% abundance of this isotope. From analysis of the line shape, an upper limit of 0.0006 cm^{-1} could be placed on the over-all width of any such structure, corresponding to a nuclear moment of 0.05 nm . (auth)

3852

THE PARAMAGNETIC RESONANCE SPECTRA OF GADOLINIUM AND NEODYMIUM ETHYL SULPHATES. B. Bleaney, H. E. D. Scovil, and R. S. Trenam (Univ. of Oxford, England). *Proc. Roy. Soc. (London)* **A223**, 15-29 (1954) Apr.

Accurate measurements of the paramagnetic resonance spectra of gadolinium and neodymium ethyl sulphates have been made both in strong magnetic fields at a wave length of 3 cm and in weak fields at wave lengths between 6 and 22 cm . The Gd^{3+} ion is in an ^6S state, whose levels are split by the action of the crystalline electric field, which is assumed to have C_{3h} symmetry. The results are consistent with this supposition, except for some discrepancies in the position of the zero field lines, whose origin is not certain. The main parameters in the spin Hamiltonian are evaluated, and the spectroscopic splitting factor is found to be isotropic at 1.990 ± 0.002 . The Nd^{3+} ion is in a $^4\text{I}_{9/2}$ state, which is split by the crystal field leaving a Kramers doublet as the ground state. The hyperfine structure due to the two odd isotopes 143 and 145 has been measured and gives the ratio of the nuclear magnetic moments ($143/145$) as 1.6083 ± 0.0012 . Some small discrepancies in the positions of the hyperfine lines in zero field are found, which prevent the determination of accurate values of the nuclear electric quadrupole interaction. The theory of Elliott & Stevens (1953^b) leads to values of 1.0 and 0.62 nuclear magnetons for the moments of isotopes 143 and 145, respectively, with an uncertainty of about $\pm 25\%$ arising from lack of a precise value for r^{-3} , where r is the electron-nuclear distance. (auth)

3853

ANGULAR CORRELATION OF NUCLEAR RADIATIONS. M. E. Rose (Oak Ridge National Lab., Tenn.). *Science* **118**, 635-42(1953) Nov. 27.

The advantages of angular correlation studies are discussed in connection with problems on nuclear structure. Mechanisms giving rise to isotropic and anisotropic correlations are analyzed with respect to their value in determining properties of fundamental importance in nuclear theory. (K.S.)

3854

NUCLEAR PHOTOEFFECT AT HIGH ENERGIES. Yu. K. Khokhlov (Physical Inst. im P. H. Lebedeva, Russia). *Zhur. Eksptl'i Teoret. Fiz.* **23**, 241-5(1952) Sept. (In Russian)

The nuclear photoeffect is shown at photon energies of 100 to 300 Mev . The model of free particles is used. The

interaction of nucleons with potential $(g^2/r)e^{-\lambda r}$ is found. The complete results and differential effective cross sections and the question of nuclear behavior after absorption of photons are considered. (tr-auth)

3855

BINDING ENERGY AND SINGLE PARTICLE MODEL OF THE ATOMIC NUCLEUS. K. Woeste (Univ. of Marburg a. d. Lahn, Germany). *Z. Physik* **137**, 228-37(1954). (In German).

It is shown that the binding energy of the nucleus in the single-particle model can be described fundamentally as well as quantitatively. Within the limits of this model it appears that the nucleus can exist only within the narrow Gamow-Bach area. Outside the area the number of nucleons is greater than the number of existing levels in the single-particle potential corresponding to this nucleon number. The influence on the term width of the nuclear spectra was discussed. (tr-auth)

NUCLEAR REACTORS

3856

ENERGY RELEASED PER FISSION IN THE BULK SHIELDING REACTOR. J. L. Meem (Oak Ridge National Lab., Tenn.). *Nucleonics* **12**, No. 5, 62(1954) May.

By comparing the temperature rise in a special fuel element with the fission rate, the energy released per fission in the Bulk Shielding Reactor was found to be $190 \pm 5\text{ Mev}$. (A.G.W.)

3857

NUCLEAR POWER PLANTS FOR SHIP PROPULSION. F. E. Crever and T. Trocki (Knolls Atomic Power Lab., Schenectady, N. Y.). *Elec. Eng.* **73**, 331-5(1954) Apr.

Two prototype submarine atomic power plants are being developed: the Submarine Thermal Reactor and the Submarine Intermediate Reactor. Their fundamentals are discussed as are those of a gas-cooled reactor power plant. (auth)

3858

METALS FOR REACTOR-CORE CONSTRUCTION. Henry A. Saller (Battelle Memorial Inst., Columbus, Ohio). *Science* **119**, 4-8(1954) Jan. 1.

The properties required of metals used for reactor-core construction are reviewed. Materials used for fuels, cladding and structural materials, moderators, and control materials are discussed. (C.H.)

3859

DESIGN AND CONSTRUCTION OF WATER BOILER NEUTRON SOURCE. Ralph Chalker (North American Aviation, Inc., Downey, Calif.). *Science* **119**, 9-15(1954) Jan. 1.

Design, construction, operating data, and cost factors are reported for a low-powered water boiler neutron source. Diagrammatic drawings and photographs showing instrumentation are included. (cf. NSA 8-2257.) (C.H.)

3860

THE ENGINEERING DESIGN OF THE NORTH AMERICAN AVIATION HOMOGENEOUS GRAPHITE RESEARCH REACTOR. A. Macneil Stelle (North American Aviation, Inc., Downey, Calif.). *Science* **119**, 15-21(1954) Jan. 1.

The proposed homogeneous graphite reactor described may be operated safely in a highly populated area, is safe for unskilled persons to perform experiments in and around, has no hazardous effluents, and has a low construction cost. In addition to being a general research tool, the reactor includes facilities for the production of radioisotopes. The reactor would operate at a power of 135 kw with 1×10^{12} neutrons/cm²/sec available in the experimental facilities. (C.H.)

NUCLEAR TRANSFORMATION

3861

Palmer Physical Labs., Princeton Univ.

THE ANGULAR DISTRIBUTION OF DEUTERONS FROM N^{14} (f,d) N^{13} . K. G. Standing. Mar. 12, 1954. 7p. (NYO-6420)

The reciprocity of (d,p) and (d,n) stripping reactions to (p,d) and (n,d) pickup processes is investigated to yield information on the spins and parities of nuclear states. An experimental arrangement for distinguishing deuterons from the high proton background is described. Experiments with the $N^{14}(p,d)N^{13*}$ reaction gave an angular distribution of deuterons which indicates an $l_n = 1$ angular momentum transfer, showing that N^{13} and N^{14} ground states have opposite parity, consistent with the assignment of 1^+ to the N^{14} ground state. No deuterons from the first excited state of N^{13} were detected. It is reasoned from this result that the admixture of $(p)^{-4} s^2$ and $(p)^{-4} sd$ configurations in the N^{14} ground state must be small. (K.S.)

3862

PHOTONUCLEAR REACTIONS. Arthur I. Berman (Stanford Univ., Calif.). *Am. J. Phys.* **22**, 277-90(1954) May.

The significant aspects of photonuclear processes are reviewed in terms of the trends in research since their discovery in 1934. Experimental techniques with high-energy x radiation, which are currently employed in these investigations, are described. (auth)

3863

CONVERSION COEFFICIENTS OF THE ISOMERIC γ -RAY IN THE DECAY OF Ba^{137} . A. H. Wapstra (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* **7**, No. 3, 275-7(1954). (In English)

From β -spectrometer measurements on Cs^{137} the K-conversion coefficient of the 662-kev transition in Ba^{137m} was found to be 0.093 ± 0.006 (M4 transition) and the K/L ratio 5.8 ± 0.3 . The Kurie plot is straight down to 75 kev if a special correction factor is used. (auth)

3864

ISOLATION AND MEASUREMENT OF THE HELIUM-4, HELIUM-3 AND TRITIUM PRODUCED IN STEEL BY 340 MEV PROTON BOMBARDMENT. G. R. Martin, S. J. Thomson, and G. Wardle (Univ. of Durham, England), and K. I. Mayne (Clarendon Lab., Oxford, England). *Phil. Mag.* (7) **45**, 410-12(1954) Apr.

The small amounts of He^4 , He^3 , and H^3 produced in a block of steel bombarded with 340-Mev protons have been isolated. Measurements have been made of the total helium by a gas-volumetric method of the tritium by counting of the associated β particles, and of the He^3 : He^4 ratio by mass spectrometry. The ratio He^4 : He^3 : H^3 has been found to be 1.00:0.048:0.078; this result is discussed in the light of Le Couteur's theory of nuclear evaporation. (auth)

3865

PROTON-GAMMA ANGULAR CORRELATIONS AND GAMMA-RAY ANGULAR DISTRIBUTIONS IN THE $^{10}B(\alpha, \gamma)^{13}C$ REACTION. A. G. Stanley (Cavendish Lab., Cambridge, England). *Phil. Mag.* (7) **45**, 430-40(1954) Apr.

The angular distributions of the high-energy γ rays (a mixture of 3.7- and 3.9-Mev γ rays) and of the low-energy γ rays (0.2 Mev) from the $B^{10}(\alpha, \gamma)C^{13}$ reaction and the angular correlations of the high-energy gamma rays with the emitted protons have been measured at five α -particle resonances at 1.13, 1.51, 1.64, 1.68, and 1.83 Mev. These experiments confirm the assignment of spins and parities 4^- , 3^- , and 4^+ to excited levels of N^{14} at 12.42, 12.69, and 12.78 Mev and spins and parities $3/2^-$ and $5/2^+$ to excited levels of C^{13} at 3.68 and 3.89 Mev. (auth)

3866

THE $He^3 + He^3$ REACTIONS. W. M. Good, W. E. Kunz, and C. D. Moak (Oak Ridge National Lab., Tennessee). *Phys. Rev.* **94**, 87-91(1954) Apr. 1.

A study has been made in the energy range up to 800 kev of He^3 capture on He^3 and the reactions that accompany this capture. The proton energy spectrum was found to confirm an earlier observation that the capture is followed by two modes of disintegration, viz., into two protons and an α particle, and into a proton and Li^5 . Improved resolution and statistics give no evidence of well-defined groups of protons of energy less than the Li^5 ground-state group. The total reaction cross section was observed to rise monotonically in a manner suggesting partial waves of l greater than one. At 200 kev the cross section is at least 2.5 microbarns, substantiating the fact that the capture of He^3 on He^3 is the dominant reaction terminating the p-p cycle for stellar production of energy. (auth)

3867

 ^{240}Pu AND ITS SPONTANEOUS FISSION. O. Chamberlain, G. W. Farwell, and E. Segrè (Univ. of California, Berkeley). *Phys. Rev.* **94**, 156(1954) Apr. 1.

Measurements of spontaneous fission of Pu^{239} show that neutron irradiation of this substance forms a body with a high spontaneous-fission rate. This substance is with practical certainty Pu^{240} and has a spontaneous-fission rate of approximately 1.6×10^6 fissions/g hr. Pu^{239} itself has a spontaneous-fission rate of the order of 40 fissions/g/hr. (auth)

3868

ENERGY SPECTRUM OF SPONTANEOUS FISSION FRAGMENTS. Emilio Segrè and Clyde Weigand (Univ. of California, Berkeley). *Phys. Rev.* **94**, 157-8(1954) Apr. 1.

The energy spectrum of spontaneous fission fragments of Pu^{240} is compared with the same spectrum for slow-neutron fission of Pu^{239} . No significant difference was found, and the interpretation of this result is discussed. (auth)

3869

SPONTANEOUS FISSION SYSTEMATICS. John R. Huizenga (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **94**, 158-60(1954) Apr. 1.

Previous correlations of spontaneous-fission half lives vs. Z^2/A predict that the half lives of even-even isotopes increase with A. A deviation from the above correlation is discussed, and it is shown that the spontaneous-fission half lives of the even-even isotopes go through a maximum with increasing A. The shorter spontaneous-fission half lives beyond the maximum may be a result of the greater deformations of the larger-A nuclides. Some comments are made on fission thresholds. (auth)

3870

ANGULAR CORRELATIONS IN THE $Be^9(d, \gamma)Be^{10}$ AND $Be^9(d, \alpha)\gamma Li^7$ REACTIONS. L. Cohen, S. S. Hanna, and C. M. Class (Johns Hopkins Univ., Baltimore). *Phys. Rev.* **94**, 419-25(1954) Apr. 15.

The (d, γ) correlation at $E_d = 0.84$ Mev was measured under the following conditions: (1) proton direction fixed at 0° to the deuteron beam, γ direction varying, (2) proton direction fixed at 90° to the beam, γ direction varying in the deuteron-proton plane, and (3) proton direction fixed at 90° γ direction varying in the 90° plane, perpendicular to the beam. The three correlations were different and showed varying amounts of anisotropy. The appearance of terms in $\cos^4\theta$ in these correlations indicates that the spin of the first excited state of Be^{10} is ≥ 2 . Coupled with other information on the state, this result gives a spin assignment of 2. A qualitative discussion of the correlations is given, and the effect of the deuteron

stripping process is considered. The $(d, \alpha\gamma)$ correlation was also measured with the α direction fixed at 90° to the beam and the γ direction varying in the deuteron-alpha plane. Failure to detect a departure from isotropy again confirms the assignment of $1/2$ to the spin of the first excited state of Li^7 . (auth)

PARTICLE ACCELERATORS

3871

ON THE THEORY OF THE VAN DE GRAAFF ELECTRO-STATIC GENERATOR. A. W. Simon (Alabama Polytechnic Inst., Auburn). *Am. J. Phys.* **22**, 318-26(1954) May.

The detailed quantitative theory of a two-carrier, constant potential, electrostatic generator is given. It is shown that if the inductor of such a machine is held at constant potential, the collector voltage also approaches a constant value, which is proportional to the potential of the inductor, the factor of proportionality depending only on the geometry of the machine. It is shown that a Van de Graaff machine can be considered as a generator of the same type except that the two separate carriers are replaced by a single continuous belt. Some erroneous conclusions commonly made with respect to the action of the Van de Graaff machine are discussed. It is pointed out that a possible advance in the application of belt-type generators is operation in series to attain higher voltages. (auth)

3872

DESIGN STUDY OF A STRONG-FOCUSING ELECTRON-SYNCHROTRON. Erik Smars and Olle Wernholm (Royal Inst. of Tech., Stockholm, Sweden). *Arkiv Fysik* **7**, No. 5, 463-72(1954). (In English)

The design of an electron synchrotron in which the particle energy is 500 or 1000 Mev was studied. The conditions for the parameters are derived, and the acceleration mechanisms are discussed. The numerical values of possible machine parameters are tabulated. (J.S.R.)

3873

CONCENTRATION OF A CYCLOTRON BEAM BY STRONG FOCUSING LENSES. F. B. Shull, C. E. MacFarland, and M. M. Bretscher (Washington Univ., St. Louis, Mo.). *Rev. Sci. Instr.* **25**, 364-7(1954) Apr.

A pair of strong-focusing magnetic lenses has been used to concentrate a part of the external beam from the Washington University cyclotron. The lenses focus the beam at distances up to more than 4 m beyond the end of the cyclotron. This produces approximately an eightfold improvement in beam intensity. (auth)

3874

CYCLOTRON BEAM ENERGY DETERMINATION BY A TIME-OF-FLIGHT METHOD. J. H. Manley and M. J. Jakobson (Univ. of Washington, Seattle). *Rev. Sci. Instr.* **25**, 368-9(1954) Apr.

A simple time-of-flight method has been employed as a means of measuring cyclotron beam energy. Through use of a movable and a fixed stilbene scintillation detector, a phase delay measured in terms of the cyclotron frequency is introduced by the flight time of the beam particles. Results good to 2% in energy have been obtained. These have less precision than the direct errors of the method, largely because of cyclotron instabilities. (auth)

RADIATION ABSORPTION AND SCATTERING

3875

Hanford Works

ABSORPTION OF POLYCHROMATIC X-RAYS AS A FUNCTION OF ATOMIC NUMBER AND SOURCE VOLTAGE. Maurice C. Lambert. Dec. 14, 1953. 27p. Contract W-31-109-Eng-52. (HW-30190)

X-ray absorption coefficients were measured for aqueous

solutions of 35 compounds and ions of 25 elements distributed throughout the periodic chart. The coefficients have been determined for polychromatic x rays produced at voltages of 25 to 75 kvp and for solution path lengths of 12 and 30 mm. The data are applicable to organic as well as to aqueous solutions, and the absorption values for several solvents are also given. Absorption coefficients for elements of atomic numbers between one and 41 and for those over about 66 increase in the same order as their atomic number. They increase only very slightly with voltage. Elements 42 to 65, whose K-absorption edges are in the range of the effective wave lengths of the polychromatic x rays employed show an anomalous behavior. For the elements investigated in this middle group, the order of increasing absorption is the reverse of that of their atomic number. Their absorption coefficients are considerably smaller at 75 kvp than would be expected by extrapolation from the lighter elements, and smaller still (by a factor of two) at 25 kvp, so that a decrease in voltage results in a marked decrease in absorption relative to that of the heavy metals. The data presented permit the absorption coefficients for ions of most elements to be estimated at source voltages between 25 and 75 kvp, to determine the magnitude of absorption due to interfering elements, to select the voltage which gives the smallest error from extraneous substances, and to determine approximate absorption coefficients for various path lengths. (auth)

3876

Connecticut Univ.

A STUDY OF ATOMIC COLLISIONS. TECHNICAL REPORT No. 2. COLLISIONS BETWEEN IONS AND ATOMS AT KILOVOLT ENERGIES. Edgar Everhart, Gerald Stone and Robert J. Carbone. Apr. 20, 1954. 22p. Contract DA-19-059-ORD-1377. (NP-5134)

An analysis is made of the phenomena to be expected when an ion whose energy is of the order of one hundred thousand electron volts strikes stationary atoms of a target gas. A treatment of the interchange of energy during such a collision is followed by a discussion of the differential cross sections for large angle collisions. (auth)

3877

Stanford Univ.

PHASE SHIFT CALCULATION OF HIGH ENERGY ELECTRON SCATTERING. D. R. Yennie, D. G. Ravenhall, and R. N. Wilson. Mar. 1954. 41p. Contract AF-18(600)545, Technical Report No. 6. (NP-5148)

The details of a phase shift calculation of high energy electron scattering by nuclei are given, together with some preliminary results. A new method for summing the Legendre series for the Coulomb scattering amplitude is described. The results indicate that the first Born approximation does not give cross sections accurate enough for a reliable interpretation of the experiments. From a comparison of the few theoretical cross sections already obtained with the experiments in gold at 125 Mev, very tentative conclusions about the nuclear charge distribution are drawn. It is pointed out that an analysis of results at two or more energies will be a much more sensitive test of possible charge distributions. (auth)

3878

Radiation Lab., Univ. of Calif., Livermore

ANALYSIS OF PROTON-PROTON SCATTERING AT 9.7 MEV. Harold H. Hall. Mar. 8, 1954. 8p. Contract W-7405-eng-48. (UCRL-4314)

The Berkeley data on the 9.7-Mev differential scattering cross section have been subjected to a phase-shift analysis. An S-phase shift in agreement with earlier work has been found, but with somewhat better precision. This value agrees with that expected from a Yukawa potential. This

experiment shows some suggestion of a repulsive P-state interaction, while the Los Alamos data show a similar but attractive P-state interaction. It is observed that the apparent discrepancy in the small-angle differential scattering cross section is large enough to warrant further measurements in the small-angle region. (auth)

3879

DISINTEGRATION OF NEGATIVE IONS BY COLLISIONS WITH ATOMS. V. M. Dukelskii [Dukel'skiy] and E. Ya. Zandberg. Translated from Zhur. Eksptl'. i Teoret. Fiz. 21, 1270-83(1951). 27p. (AEC-tr-1889)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 6-3705.

3880

ON THE RELATIVE STOPPING POWER OF CERTAIN SUBSTANCES FOR Po- α PARTICLES. Bahriye Yaramis (University of Istanbul). Rev. fac. sci. univ. Istanbul A, 18, 369-83(1953) Oct. (In English)

A special G-M counter having an end-mica window, and an appropriate counter circuit have been made for the purpose of determining the relative stopping power of certain substances for Po α particles. The relative stopping powers of O₂, CO₂, CH₄, C₂H₄, C₂H₂ and C₆H₆ were determined to be: 1.052, 1.500, 0.894, 1.342, 1.120, and 3.364, respectively. The relative stopping power of carbon was calculated by means of the additive law of W. H. Bragg and R. D. Kleeman from CO₂ and O₂. The result was found to be 0.896. (auth)

3881

THE SCATTERING OF MEDIUM FAST ELECTRONS IN A VERY SMALL ANGLE. Friedrich Lenz (Rheinisch-Westfälischen Institut für Übermikroskopie, Düsseldorf, Germany). Z. Naturforsch. 9a, 185-204(1954) Mar. (In German)

A theoretical and experimental investigation was made of the elastic and inelastic scattering of electrons in the acceleration range 50 to 100 kv. Only a small correction was needed for the relativity effect, and the Born approximation was valid. Calculation of the scattering factor by the Thomas-Fermi model in the case of elastic scattering leads to a small error, but a method is given for avoiding it. A formula for inelastic scattering is given. The total cross sections for C, Cr, and Au are evaluated. (J.S.R.)

3882

TECHNIQUES AND APPLICATIONS OF NEUTRON DIFFRACTION. M. K. Wilkinson (Oak Ridge National Lab., Tenn.). Am. J. Phys. 22, 263-76(1954) May.

A brief review is given of the advances which have been made in the field of neutron diffraction during the past several years. The experimental techniques that have been developed are discussed, and illustrations are cited of several fields of application where information is obtained which would be very difficult or impossible to obtain by x-ray or electron diffraction. (auth)

3883

THE THEORY OF NUCLEON-NUCLEON SCATTERING AT HIGH ENERGIES. K. Fincke (Universität Hamburg, Germany). Ann. Physik 14, 97-120(1954) Feb. (In German)

According to the usual invariance progression up to the order of magnitude v/c , the most general permissible interaction tendency between two nucleons was based on the calculation of the effective cross section of nucleon-nucleon scattering. Along with the Case-Pais theory and the Jastrow theory a third theory is presented as a special case which leads to an understanding of the experimental charge-independence. None of the theories is yet able to explain the isotropy and the constant of the proton-proton effective cross section at high energies. From a qualitative inspection it is seen that the Jastrow theory and the

newly developed theory are well suited for a description of experimental results, but the Case-Pais theory is not. (tr-auth)

3884

THE PROBLEM OF MULTIPLE SCATTERING. E. P. Wigner (Princeton Univ., New Jersey). Phys. Rev. 94, 17-25(1954) Apr. 1.

Multiple scattering can be regarded as a succession of elementary events. The distribution function for the particles which have gone through $n + 1$ elementary events is the convolution of two functions. The first of these expresses the scattering law; the second one is the distribution function for particles which have gone through n events. It is well known that such convolutions can be calculated very easily by means of Fourier transforms if the elementary event is the traversal of a free path in an arbitrary direction. In this case, the Fourier transform of the convolution is the product of the Fourier transforms of the convolvents. In the case of more general scattering laws, integrals over products of the distribution function, and of representations of the group which leaves the scattering law invariant, play the same role which the Fourier transforms play in the aforementioned case. From the present point of view, the exponential in the Fourier transform is a representation of the displacement group. It is shown that one can solve several problems of multiple scattering on the basis of the above observation. These problems include the scattering of a point particle without change of energy but an arbitrary angular distribution, and several more involved problems. (auth)

3885

MEAN EXCITATION POTENTIALS. David O. Caldwell and J. Reginald Richardson. (Univ. of California, Los Angeles). Phys. Rev. 94, 79(1954) Apr. 1.

Previous experimental data of Sachs and Richardson on the most probable energy loss of 18-Mev protons on passing through thin foils have been used in connection with the theory of Symon to calculate the mean excitation potential I . The result for aluminum is $I = 164 \pm 3$ electron volts. (auth)

3886

INELASTIC SCATTERING OF NEUTRONS. E. A. Eliot, D. Hicks, L. E. Beghian, and H. Halban (Clarendon Lab., Oxford, England). Phys. Rev. 94, 144-51(1954) Apr. 1.

Experiments have been carried out on the inelastic scattering of 2.5 Mev neutrons by chromium, bismuth, iron, and indium, using scintillation counters. Inelastically scattered neutrons and gamma rays were observed in a stilbene crystal and the results interpreted by a ratio method. Gamma radiation alone was observed in a sodium iodide crystal, using a normalization technique to eliminate the neutron background. The following levels were identified: in chromium 1.42 ± 0.05 Mev (cross-section 1.0 ± 0.2 barns); in bismuth 1.58 ± 0.05 Mev (0.6 ± 0.2 barns) and 0.85 ± 0.02 Mev (1.2 ± 0.3 barns); and in indium 0.92 ± 0.04 Mev (0.4 ± 0.1 barns) and 0.61 ± 0.06 Mev (0.2 ± 0.1 barns). Preliminary experiments with iron gave a level of 0.91 ± 0.15 Mev (1.0 ± 0.3 barns). (auth)

3887

COULOMB EXCITATION BY MEANS OF BOMBARDMENT WITH VARIOUS PARTICLES. Jørgen H. Bjerregaard and Torben Huus (Univ. of Copenhagen, Denmark). Phys. Rev. 94, 204-5(1954) Apr. 1.

It is shown that the cross section for Coulomb excitation, produced by the electric multipole field of order λ of the impinging particle, may be given by

$$\sigma = C_{\lambda} \{Z_2, \Delta E, B\} Z_1^2 (m/Z)^{2\lambda/3} \xi^{(2-4\lambda)/3} f_{\lambda} \{ \xi \},$$

where C_λ is a constant depending on λ and the target nuclei, Z_1 and m are the charge and reduced mass of the bombarding particle, B is the reduced transition probability for the target nuclei, and ΔE is the excitation energy. $\xi = Z_1 Z_2 e^2 \Delta E / \hbar m v^3$, where v is the velocity of the bombarding particle. The predictions of this theory were tested by bombarding W with protons, deuterons, and α particles of 1 to 2 Mev. Good agreement was achieved, confirming the expected E2 character of the excitation. Consideration is given to the problem of which particle gives the highest excitation yield for a given energy range. (K.S.)

3888

EMISSION OF δ^- - AND X-RAYS FROM TARGETS BOMBARDED BY ACCELERATED IONS. Črtomir Zupančič and Torben Huus (Univ. of Copenhagen, Denmark). *Phys. Rev.* **94**, 205-6(1954) Apr. 1.

Background radiations present in Coulomb excitation experiments, due to the ejection of atomic electrons and bremsstrahlung in the nuclear Coulomb field, are discussed. K-electron emission due to heavy-particle bombardment corresponded to differential cross sections per atom of the order $d\sigma \approx 10^{-16} Z_1^2 e^4 (E_1/A_1) Z_2^4 E_2^{-2} dE \delta$, where the 1 subscripts refer to the bombarding particle and the 2 subscripts refer to the target material. This cross section is larger than that reported by Henneberg (*Z. Physik* **86**, 592(1933)), and it is thought that the observed electrons were mainly L electrons. Bremsstrahlung from the excitation of Sn by 1.75-Mev protons was found to agree with a theoretical cross section previously given by Sommerfeld for a bare nucleus (*Ann. Physik* (5) **11**, 257(1931)). (K.S.)

3889

SMALL-ANGLE NEUTRON-PROTON SCATTERING AT 90 MEV. Owen Chamberlain and James W. Easley (Univ. of California, Berkeley). *Phys. Rev.* **94**, 208-9(1954) Apr. 1.

The relative n-p differential cross section has been measured for several angles near 0° by allowing 90-Mev neutrons, stripped from 190-Mev deuterons, to bombard liquid H. A marked similarity of the cross section at 0° is noted to that in the region of 180° . (K.S.)

3890

ELECTRON-ELECTRON AND POSITRON SCATTERING MEASUREMENTS. Arthur Ashkin, Lorne A. Page, and W. M. Woodward (Cornell Univ, Ithaca, N.Y.). *Phys. Rev.* **94**, 357-62(1954) Apr. 15.

A counter experiment is described which measures the absolute differential electron-electron scattering cross section in the energy interval 0.6 to 1.2 Mev and the absolute differential positron-electron scattering cross section in the energy interval 0.6 to 1.0 Mev. The ratio of these cross sections is also measured with somewhat increased accuracy. The technique of measurement combines good resolution with large energy transfers between the particles, to permit a sensitive test of the relativistic features of the Møller and Bhabha formulas. The results verify the Møller formula within the 7% experimental error. The Bhabha formula is verified within the 10% experimental error. The ratio of the Møller to the Bhabha formula is verified within about 8% experimental error. (auth)

3891

A COVARIANT TREATMENT OF MESON-NUCLEON SCATTERING. Maurice M. Lévy (Ecole Normale Supérieure, Paris, France). *Phys. Rev.* **94**, 460-8(1954) Apr. 15.

A covariant equation for the meson-nuclear system is presented, in which the renormalization of divergent processes is carried out to all orders. A closed expression is given for their contribution to the wave function after re-

normalization, while the contribution coming from finite processes still involves a series expansion. Exact formulas are derived for the scattering phase shifts. (auth)

3892

APPLICATION OF VARIATIONAL METHODS TO INTERMEDIATE AND HIGH-ENERGY SCATTERING. E. Gerjuoy (Univ. of Pittsburgh, Penna.) and David S. Saxon (National Bureau of Standards, Los Angeles, Calif.). *Phys. Rev.* **94**, 478-91(1954) Apr. 15.

The application of Schwinger's variational principle to scattering by a Yukawa potential is studied. A detailed comparison of the Born approximation, variational, and exact results is given in the energy region from 20 to 150 Mev for a potential strength and range appropriate to the ^3S neutron-proton interaction. Comparison with the second Born approximation is also made. The utility of the variational principle is discussed, and consideration is given to the high-energy limit. It is judged that for most potentials, the variational formulation without elaborate trial functions will be better than the Born approximation. The relation between the variational principles for the total scattering amplitude and for the phase shifts is analyzed. A new formulation intermediate between these two is presented as a compromise between the simplicity of the former and the accuracy of the latter. With the potential studied, use of this formulation leads to considerably better results for the total amplitude than does the original principle. (auth)

RADIATION EFFECTS

3893

North American Aviation, Inc.
MECHANICAL EFFECTS OF IONIZING RADIATION IN THE ALKALI HALIDES. D. R. Westervelt. May 1, 1954. 26p. Contract AT-11-1-GEN-8. (NAA-SR-888)

Experiments are described which prove that lattice defects are generated in alkali halide crystals by exposure to any kind of ionizing radiation in concentrations sufficient to cause changes which are comparable to the most severe effects of radiation damage by massive particles. Large changes in the mechanical and optical properties result from irradiations which are incapable of directly causing atomic displacements. A series of isothermal anneals isolated several distinct hardness annealing processes in damaged crystals and facilitated correlation of the mechanical damage with specific optical effects. The observed influence of radiation on hardness was related to known effects of divalent impurities on the yield point and tensile strength, a correlation which leads to interpretation of the mechanical effects of radiation in terms of a vacancy mechanism. Experiments are described which will provide a crucial test of the theory of vacancy-induced hardness and lead ultimately to a separation of the effects of ionization from those which are due to direct atomic displacements. The separation of ionization and displacement effects is of fundamental importance in the study of radiation damage in insulating materials. (auth)

3894

IRRADIATION OF TRANSISTORS. C. D. Florida, F. R. Holt, and J. H. Stephen (Atomic Energy Research Establishment, Harwell, Berks, England). *Nature* **173**, 397-8(1954) Feb. 27.

Irradiation experiments on commercial point-type transistors show that if a transistor is given a radiation dose of about 10^{14} neutrons/cm², the time of fall of collector current from the value limited by an external resistance is decreased. The same radiation dosage was given to monocrystalline Ge. A rise in resistivity from 2.03 ohm cm to 2.24 ohm cm and a decrease in hole

life time from 1.6 to 0.6 μ sec were observed, with little change in hole mobility. (J.A.G.)

RADIOACTIVITY

3895

Los Alamos Scientific Lab.

A FORMULATION OF THE THEORY OF ALPHA PARTICLE DECAY FROM TIME-INDEPENDENT EQUATIONS. R. G. Thomas. [1953] 22p. Contract [W-7405-eng-36]. (AECU-2860)

The theory of alpha decay is formulated from the time-independent R-matrix theory of nuclear reactions. It is shown that the most appropriate proper solutions are the ones with radial nodes near the channel radii, and therefore the Teichmann-Wigner sum rules involving the alpha-particle kinetic energy may be applied. Exact and approximate relations are given for the dependence on the angular momentum of the decay rate for the square well model. Barrier penetration formulas are given which include estimates of the effects of an external nuclear exponential potential and the atomic electron screening. (auth)

3896

Knolls Atomic Power Lab.

THE PRODUCTION OF $\text{Nb}^{93\text{m}}$ BY THE PILE NEUTRON IRRADIATION OF NIOBIUM. R. P. Schuman. [1953] Contract [W-31-109-Eng-52]. 2p. (AECU-2866)

A sample of Nb, under long neutron irradiation in the Chalk River Pile, was carefully analyzed for the presence of low-energy radiation in addition to the 0.50-Mev β and 0.70-, 0.87-, and 1.57-Mev γ rays previously reported. A spectrum of weak electrons was found with peaks at 8.5 and 23 kev. A K_α x ray was noted at 16 kev which probably contained some K_β radiation. The x radiation is attributed to K and L conversion in $\text{Nb}^{93\text{m}}$, giving the observed electron activity by a (n, n^1) reaction with Nb^{93} . The cross section for formation by such a process is about 0.8 mb. (K.S.)

3897

Harvard Univ.

NEW ISOTOPES OF NIOBIUM: Nb^{89} AND $\text{Nb}^{90\text{m}}$. R. M. Diamond. Mar. 30, 1954. 9p. Contract AT-(30-1)-1461. (NYO-6379)

A new (1.9 ± 0.3) -hr activity was found in Nb fractions isolated from proton-irradiated Nb and Zr metal foils. By identification of the 78-hr daughter activity, the mass assignment has been made to Nb^{89} . Evidence indicates that the decay is a simple positron emission of (3.0 ± 0.4) -Mev maximum energy. Evidence was also obtained for the existence of the $1/2^-$ -isomeric state in Nb^{89} , which decays with a (0.8 ± 0.3) -hr half life by positron emission to the similar 4.4-min state in Zr^{89} . (auth)

3898

K-CONVERSION COEFFICIENTS OF γ -TRANSITIONS OCCURRING IN THE DECAY OF $\text{Kr}^{85\text{m}}$, $\text{Xe}^{129\text{m}}$, $\text{Xe}^{131\text{m}}$, Xe^{133} , AND $\text{Xe}^{133\text{m}}$. I. Bergström, S. Thulin, A. H. Wapstra, and B. Åström (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* 7, No. 3, 255-63 (1954).

The K-conversion coefficients of γ rays in the decays of $\text{Kr}^{85\text{m}}$, $\text{Xe}^{129\text{m}}$, $\text{Xe}^{131\text{m}}$, Xe^{133} , and $\text{Xe}^{133\text{m}}$ have been measured by combination of β spectrometer and scintillation methods. The empirical K/L curve of Goodhaber and Sunyar for M4 transitions has been slightly corrected. (auth)

3899

K-CONVERSION COEFFICIENT OF THE ISOMERIC γ -RAY IN Ag^{106} . A. H. Wapstra (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* 7, No. 3, 265-8 (1954). (In English)

By scintillation spectrometer measurements the K-

conversion coefficient of the 40-sec $\text{Ag}^{106\text{m}}$ isomeric transition is found to be 9.5 ± 1 (E3 transition). (auth)

3900

THE DECAY OF $\text{Xe}^{129\text{m}}$. Sigvard Thulin (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* 7, No. 3, 269-73 (1954). (In English)

A second γ transition in the decay of $\text{Xe}^{129\text{m}}$ has been found. The energy of the corresponding γ ray is 40.0 ± 0.5 kev, and the K/L + M ratio is 4.3 ± 0.7 . A decay scheme is presented. (auth)

3901

THE DECAY OF Bi^{207} . A. H. Wapstra (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* 7, No. 3, 279-87 (1954). (In English)

Bi^{207} decays by electron capture, 80% of the decays leading to a 0.9-sec isomeric state in Pb^{207} which de-excites by the successive emission of 1060 and 565-kev γ rays and 20% to the 565-kev level. The total decay energy 2050 kev. The Auger conversion probability for lead is 0.043 ± 0.015 . (auth)

3902

ON THE DECAY OF Hg^{203} . Sigvard Thulin and Karl Nybö (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* 7, No. 3, 289-91 (1954). (In English)

The maximum energy of the Hg^{203} β continuum is found to be 210 ± 2 kev. The K internal conversion coefficient of the 279-kev γ ray is 0.154 ± 0.015 , and the K/(L + M) ratio is 2.8 ± 0.2 . (auth)

3903

A CRITICAL COMPARISON BETWEEN SOME METHODS FOR MEASURING THE STRENGTH OF A Ra-Be NEUTRON SOURCE ABSOLUTELY. Karl-Erik Larsson (AB Atomenergi, Stockholm, Sweden). *Arkiv Fysik* 7, 323-42 (1954). (In English)

The neutron yield of a 250-mg Ra-Be source has been determined using two different methods, firstly by integrating the neutron density in a boric acid solution with a small BF_3 chamber and, second, by integration of the neutron density in pure water, using gold foils and subsequent absolute counting of the induced activity. The values found by the yield are $(2.57 \pm 0.12) \times 10^6$ neutrons/sec with the BF_3 chamber method and $(2.62 \pm 0.08) \times 10^6$ neutrons/sec with the gold foil method. The neutron yield of this source has also been directly compared with the yield of a Harwell standard source, the result of the comparison being $(2.64 \pm 0.13) \times 10^6$ neutrons/sec, and indirectly with a Los Alamos source, giving the result $(2.55 \pm 0.21) \times 10^6$ neutrons/sec. (auth)

3904

STUDY OF THE RADIOACTIVITY OF Sb^{125} . Jean Moreau (Nobel Inst. for Physics, Stockholm, Sweden). *Arkiv Fysik* 7, No. 5, 391-7 (1954). (In French)

The decay of Sb^{125} was studied, and the spectrum measured by a coincidence method. The spectral decomposition can be obtained by subtracting the new spectrum, and the energy spectrum then has the characteristic forbidden form from which the Fermi diagram can be made linear by application of the correction coefficient. The spectral decomposition yields 4 spectra, the first of which has a form of the first forbiddenness $\Delta I = 2$ yes, which confirms the $g_{7/2}$ state of Sb^{125} and the $h_{11/2}$ of Te^{125} . A decay scheme for Sb^{125} is proposed. (J.S.R.)

3905

ON THE RADIOACTIVITY OF Rb^{87} . J. Flinta and E. Eklund (AB Atomenergi, Stockholm, Sweden). *Arkiv Fysik* 7, No. 5, 401-11 (1954). (In English)

The decay of Rb^{87} has been investigated, and the maximum energy of the β spectrum found to be 250 ± 25 kev by means of absorption in aluminum. The absorption curve shows an

excess of low-energy β particles, in agreement with the assumption that the β decay is triply forbidden. No γ or x radiations were found. The mean value found for the total β radiation from rubidium was 42.2 ± 0.7 β decays/min/mg Rb, corresponding to a half life of $(6.1 \pm 0.2) \times 10^{10}$ years for Rb⁸⁷. (auth)

3906

INTERNAL CONVERSION OF THE ZERO-ZERO TRANSITION IN RaC. David E. Alburger and Arne Hedgran (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv. Fysik* 7, No. 5, 423-5(1954). (In English)

The conversion lines of Po²¹⁴ were examined at a resolution of 0.085%. With this resolution the lines corresponding to the 1.42-Mev transition could be studied in detail. The L line had a position which agrees with that expected of L_I, although an L_{II} component could be present. The M line has the same half-width as the K line, and its position closely corresponds to M_I or M_{II}. The K-to-L ratio 5.3 ± 0.3 and the K-to-(L \pm M) ratio 4.25 ± 0.3 are in excellent agreement with the calculations of Drell. (J.S.R.)

3907

ON THE FINE α STRUCTURE OF IONIUM. Salomon Rosenblum, Manuel Valadares, Jeannine Blandin-Vial, and René Bernas. *Compt. rend.* 238, 1496-8(1954) Apr. 5. (In French)

The fine α structure of Th²³⁰ is graphed. A discussion is presented on the possibility of the levels α_2 , α_5 , α_8 , and α_7 . (J.S.R.)

3908

ON THE ANGULAR CORRELATIONS BETWEEN NUCLEAR RADIATION AND X RADIATION IN COINCIDENCE. Pierrette Benoist. *Compt. rend.* 238, 1498-9(1954) Apr. 5. (In French)

The theoretical study of angular correlations between the x radiation of rearrangement following internal conversion and nuclear radiation in coincidence has shown that there is no correlation for x , K, L_I, L_{II}, M_I, and M_{II} radiation. The L_{III} radiation gives rise to an anisotropy, but it is very weak. (tr-auth)

3909

ON THE LINE SHAPE OF MONOCHROMATIC γ RADIATION IN A SCINTILLATION SPECTROGRAPH. D. Maeder, R. Müller, (ETH, Zurich, Switzerland) and V. Wintersteiger (Phys. Inst., Belgrade, Yugoslavia). *Helv. Phys. Acta* 27, 3-44(1954) Mar. 15. (In German). (cf. NSA 6-5644)

After a brief outline of the various effects governing the "line shape" (photopeak + continuum) in a scintillation spectrometer at energies of the order 1 Mev, the general equations for computing the energy distribution of scintillations produced by monochromatic incident γ rays are established. A compilation of numerical data on the primary absorption and scattering in NaI (Tl) is given. Extrapolation of measured photo fractions to zero crystal size seems to indicate that at 1 Mev the photoabsorption cross section might be appreciably smaller than predicted by Hulme, et al. In the evaluation of the theoretical Compton distribution for an infinitely large crystal, perpendicular incidence of the primary quanta is assumed; secondary and tertiary absorption and scattering have been calculated rigorously and higher order effects taken into account by an approximate procedure. To simplify calculations for finite cylindrical crystals, it is assumed that γ rays enter the crystal only along the cylinder axis, but corrections for the case of bad collimation are developed. Curves show the modified Compton distribution and photo fraction for NaI crystals with $L = R = 0.5$ cm, 1 cm, 2 cm, 4 cm, and ∞ at different energies from 0.255 to 1.28 Mev. The corrections caused by γ rays scattered from outside into the crystal are discussed with respect to pair creation (which proves negli-

gible, as far as the apparent photo fraction is concerned, up to 2 Mev), bremsstrahlung, and range losses. The latter, as well as the hard component of the collimator scattering, become appreciable above 1 Mev, whereas the soft component produced by the collimator may be eliminated by characteristic absorbers. Experimental applications include the verification of the calculated photo fraction as a function of energy and crystal size, absolute γ ray intensity measurements, and analysis of complex line spectra such as those produced by Ga⁶⁷, In¹¹⁴, and Au¹⁹⁸. (auth)

3910

THE DISINTEGRATION OF Mo⁹⁹. Jagdish Varma and C. E. Mandeville (Franklin Inst., Swarthmore, Penna.). *Phys. Rev.* 94, 91-4(1954) Apr. 1.

The radiations of Mo⁹⁹ and Tc^{99m} have been reinvestigated by means of scintillation spectroscopy. Employing single-channel pulse-height analyzers in coincidence, it has been established that a triple cascade of gamma rays, 741 keV \rightarrow 41 keV \rightarrow 140 keV occurs. The 741-keV radiation is also coincident with a gamma ray at 181 keV by an alternate branch of de-excitation which is equally probable. Radiation at 780 keV is present but is not-coincident with other gamma rays. From these data, a disintegration scheme can be constructed. A gamma ray of energy 372 keV was also detected, and, although it appeared to have the proper half-period to be associated with Mo⁹⁹, was found to be not in immediate coincidence with beta rays of other gamma rays, suggesting that it might be related to an impurity. (auth)

3911

THE DECAY SCHEME OF Zr⁹⁵. Phillip S. Mittelman (Rensselaer Polytechnic Inst., Troy, N. Y.). *Phys. Rev.* 94, 99-102(1954) Apr. 1.

The decay scheme of Zr⁹⁵ has been studied using the techniques of beta-ray spectroscopy and beta-gamma angular correlation. The decay of Zr⁹⁵ is found to proceed by three beta gamma cascades. Two of the beta transitions are allowed and proceed to Nb⁹⁵ levels at 722.0 keV and 754.4 keV. The third beta transition is to a 235-keV level in Nb⁹⁵. From K-conversion coefficient determinations and shell theory the 722-keV and 754.4-keV levels are both assigned even parity and a spin of $\frac{5}{2}$ or $\frac{7}{2}$. (auth)

3912

DECAY OF ¹⁶⁰Tb (71 DAY). S. B. Burson, W. C. Jordan, and J. M. LeBlanc (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 94, 103-9(1954) Apr. 1.

By means of 180° internal-conversion electron spectrometers and the scintillation coincidence spectrometer, the radiations of Tb¹⁶⁰ have been studied. In addition to many of the previously reported transitions in Dy¹⁶⁰, three new gamma rays of 0.759, 1.17, and 1.26 Mev are observed. By using the energy values determined from the internal conversion studies together with beta-gamma and gamma-gamma coincidence results a decay scheme is deduced which is consistent with the experiments discussed. (auth)

3913

THE NUCLEAR SPECTRA OF Ce¹⁴⁴ AND Pr¹⁴⁴. W. S. Emmerich, W. J. Auth, and J. D. Kurbatov (Ohio State Univ., Columbus). *Phys. Rev.* 94, 110-12(1954) Apr. 1.

The nuclear spectra of Ce¹⁴⁴ and Pr¹⁴⁴ were studied with magnetic and scintillation spectrometers. The 304-keV beta transition of Ce¹⁴⁴ was found to be 70.5 percent abundant from Kurie plot analysis. For the beta spectra leading to the 134-keV and 81-keV levels, intensities of 22 percent and three percent were obtained, respectively, from internal conversion and gamma-ray data. An energy level of 175 keV in Pr¹⁴⁴ was inferred from energy balance considerations. The relative

intensities of the Pr^{144} beta transitions were determined from the abundance of the 695-kev gamma transition in Nd^{144} which was found to be 1.25 ± 0.2 percent. A spin of one and odd parity appears plausible for the 2185-kev level in Nd^{144} . (auth)

3914

RADIATIVE ELECTRON CAPTURE IN Fe^{56} . L. Madansky and F. Rasetti (Johns Hopkins Univ., Baltimore). *Phys. Rev.* **94**, 407-8(1954) Apr. 15.

The internal bremsstrahlung emitted in electron capture by Fe^{56} was studied from 14 kev to the upper energy limit at 220 kev. Fair agreement with the formula of Morrison and Schiff is observed at high energies, whereas a strong rise of the intensity occurs at low energies. The discrepancy may be due to failure of the theory to take into account the effects of nuclear charge, capture of p electrons, and forbiddenness of the transition. (auth)

3915

POTASSIUM-44. Bernard L. Cohen (Oak Ridge National Lab., Tennessee). *Phys. Rev.* **94**, 117-18(1954) Apr. 1.

Potassium-44 was produced by an (n,p) reaction on calcium and found to decay by negatron and gamma emission with a 22.0 ± 0.5 minute half life. The identification was ascertained by comparison of yields from normal and isotopically enriched calcium, cross section measurements, chemical processing, and investigation of impurity effects. The beta-ray spectrum is quite complex but includes strong components with maximum energies of about 4.9 and 1.5 Mev. The gamma-ray spectrum includes strong gammas at 1.13, 2.07, and 2.48 Mev, and a probable 3.6-Mev gamma. (auth)

3916

β -DECAY ENERGY SYSTEMATICS. Katharine Way and Marion Wood (National Bureau of Standards, Washington D. C.). *Phys. Rev.* **94**, 119-28(1954) Apr. 1.

A β -decay energy systematics is presented which exhibits linear relations for disintegration energies between atoms (Z, N) and $(Z + 1, N - 1)$ when plotted as a function of N keeping Z constant. Separate plots are necessary for odd and even values of A . The disintegration energy lines show marked discontinuities for $N = 50, 82$, and 126. There is also considerable indication of a discontinuity at $N = 28$, and in the region of $N = 20$ sharp changes in slope are observed. Proton magic numbers at 50, 82, and possibly 28 are indicated by gaps in the spacing of the disintegration energy lines. No definite sub-magic numbers are at present identifiable. Changes in the even-odd differences of neutron and proton binding energies show up as changes in the line separation pattern. The most striking pattern changes can be interpreted as due to decreases in the even-odd differences for both neutrons and protons after their respective magic numbers. The systematics is useful in estimating disintegration energies in cases where measurements have not yet been made. Part of a systematics for double β decay is also shown. (auth)

3917

THE THIRD FORBIDDEN BETA SPECTRUM OF RUBIDIUM-87. M. H. MacGregor and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). *Phys. Rev.* **94**, 138-40(1954) Apr. 1.

The use of thin-lens beta spectrometers has been extended to the measurement of an isotope of extremely low specific activity, rubidium 87. The Rb^{87} beta spectrum is third forbidden and not "unique." The spectrum gave a linear Kurie plot when the third forbidden tensor (or vector) correction factor was applied. The extrapolated value $E_{\text{max}} = 275$ kev agreed well with the results of recent investigations. An extension of a recent measurement of the Rb^{87} half-life was carried out with an enriched sample of Rb^{87} , and a value $T_{1/2} = 6.2 \pm 0.3 \times 10^{10}$ years was obtained. (auth)

3918

LONG-LIVED ISOMER OF RaE (Bi^{210}). Harris B. Levy and I. Perlman (Univ. of California, Berkeley). *Phys. Rev.* **94**, 152-5(1954) Apr. 1.

The mass assignment of a long-lived bismuth alpha activity previously reported as being an isomer of Bi^{210} has been confirmed by means of electromagnetic mass separation. The half-life of the Bi^{210} (long) is now reported to be 2.6×10^8 years. The alpha-decay energy of Bi^{210} (long) has been redetermined and found to be 5.031 ± 0.020 Mev. Comparison with the alpha-decay energy of RaE places the Bi^{210} (long) 25 kev below RaE with, however, an uncertainty of the same order of magnitude. Bi^{210} (long) has measurable β^- branching (1 part in 270) to give Po^{210} , and this gives a partial half-life of 7.0×10^8 years for this mode of decay. An unsuccessful search was made for Bi^{210} (long) as a decay product of RaD (Pb^{210}), resulting in a lower limit of 2×10^7 years for the decay of RaD to this isomer. Also, an upper limit of 1.4×10^8 years was set on the half-life for transition from RaE to Bi^{210} (long). On the basis of decay data now available, the most probable designation for the Bi^{210} (long) state is deduced to be 4—although a somewhat higher spin number could be possible. (auth)

3919

HALF-LIVES OF Pu^{240} AND Pu^{239} . G. W. Farwell, J. E. Roberts, and A. C. Wahl (Los Alamos Scientific Lab., N. M.). *Phys. Rev.* **94**, 363-4(1954) Apr. 15.

The half lives of Pu^{240} and Pu^{239} have been determined by measuring the specific α activity and the Pu^{240} content of four Pu samples which had received different amounts of neutron irradiation. With the assumption that Pu^{238} contributes 13% to the observed increase in α activity, the half life of Pu^{240} is 6300 ± 600 yr. The half life of Pu^{239} is found to be $24,400 \pm 500$ yr. (auth)

3920

A NEW ISOTOPE OF PALLADIUM, 1.5-MINUTE Pd^{113} . Harry G. Hicks and Richard S. Gilbert (California Research and Development Co., Livermore). *Phys. Rev.* **94**, 371(1954) Apr. 15.

A new isotope, 1.5-min Pd^{113} , has been isolated from the fission products of natural U bombarded with 190-Mev deuterons. The mass assignment and half life were determined by successive milkings of the 5.3-hr Ag^{113} daughter. (auth)

3921

THE RADIATIONS OF LANTHANUM-140. C. L. Peacock, J. F. Quinn, and A. W. Oser, Jr. (Tulane Univ., New Orleans, La.). *Phys. Rev.* **94**, 372-3(1954) Apr. 15.

The radiations of La^{140} have been studied with a magnetic spectrometer of radius 20 cm. The β spectrum is complex consisting of five groups whose maximum energies are 0.83, 1.10, 1.34, 1.67, and 2.15 Mev. Gamma rays with energies of 0.110, 0.130, 0.240, 0.270, 0.328, 0.485, 0.815, and 1.60 Mev, respectively, were found. The 1.60-Mev γ is very intense. A tentative decay scheme is proposed. (auth)

3922

INTERNAL BREMSSTRAHLUNG FROM P^{32} . Max Goodrich and Wilbur B. Payne (Louisiana State Univ., Baton Rouge). *Phys. Rev.* **94**, 405-7(1954) Apr. 15.

The spectral distribution of the internal bremsstrahlung associated with the β decay of P^{32} has been measured with a NaI scintillation spectrometer from 80 to 900 kev. The shape of the experimental spectrum is compared with the theoretical distribution, corrected for detector response, for three different β interactions: (1) allowed; (2) first-forbidden; scalar; (3) first-forbidden; tensor; $\Delta J = 2$, yes. The results show that of these interactions, only the allowed case gives a theoretical curve within the estimated error (10%) of the experimental points over the entire range of energy. (auth)

3923

RADIATIVE ELECTRON CAPTURE OF Fe^{55} , A^{37} , AND Ni^{59} . W. S. Emmerich, S. E. Singer, and J. D. Kurbatov (Ohio State Univ., Columbus). *Phys. Rev.* **94**, 113-16(1954) Apr. 1.

The radiative electron capture spectra of Fe^{55} , A^{37} , and Ni^{59} were studied with a scintillation spectrometer. The end-point energies were found to be 226 ± 10 kev, 815 ± 20 kev, and 1065 ± 30 kev, respectively. A method was devised to correct the experimental intensity distributions for distortions due to the Compton effect in the scintillation crystal. This was applied to the spectra of A^{37} and Ni^{59} above 320 kev. In this energy range, the experimental spectrum of A^{37} was found to agree with the calculated spectral shape. In the case of Ni^{59} , a dependence of the spectral shape on the type of transition could not be detected within present experimental limits. (auth)

3924

THE DISINTEGRATION OF Co^{55} AND I^{130} . Robert S. Caird and Allan C. G. Mitchell (Indiana Univ., Bloomington). *Phys. Rev.* **94**, 412-19(1954) Apr. 15.

The nuclear spectra of Co^{55} (18 hr) and I^{130} (12.6 hr) have been studied with the help of a magnetic lens spectrograph, a coincidence lens, and scintillation counters. Co^{55} emits γ rays having energies 0.477, 0.935, 1.41, 0.253, 1.84, and 2.17 Mev, the last three being quite weak; and four β -ray groups of energies 1.500, 1.03, 0.53, and 0.26 Mev with relative abundances of 53.3, 39.5, 4.9, and 2.3 %, respectively. A disintegration scheme is proposed. I^{130} emits γ rays of energy 0.409, 0.528, 0.660, 0.744, and 1.15 Mev together with two β -ray groups of energies 1.02 and 0.597 Mev. The energy-level scheme is discussed in the light of the collective model. (auth)

3925

A POSSIBLE RELATION BETWEEN THE PSEUDOSCALAR β COUPLING AND THE NUCLEAR SPIN-ORBIT COUPLING. E. J. Konopinski (Indiana Univ., Bloomington). *Phys. Rev.* **94**, 492-3(1954) Apr. 15.

It is suggested that there is a direct proportionality between the nuclear spin-orbit energy and the size of the nuclear moments responsible for β decay via pseudoscalar coupling. On this assumption, the observed size of the spin-orbit splitting is adequate to account for the large β moment needed for explaining the Bi^{210} spectrum, within the uncertainties in the knowledge of these phenomena. (auth)

SHIELDING

3926

North American Aviation, Inc.
MAGNETITE IRON ORE CONCRETE. J. O. Henrie. Apr. 15, 1954. 21p. Contract AT-11-1-GEN-8. (NAA-SR-880)

Crushing and handling of the magnetite iron ore which was used as the aggregate for a dense shielding concrete is discussed. The physical properties and costs of the concrete are compared to those of other concretes. The mix used has a compressive strength of 4,000 psi in 10 days. The methods used in fabricating shielding blocks are described. Recommendations for producing a low-cost, relatively high-density shielding concrete are made. The shielding blocks used in the hot cell at North American Aviation, Inc., (9 by 9 by 18 inches nominal) have a density of 3.7 g/cm³ or 230 lb/ft³ and cost \$163.50 per cubic yard. The dimensions of the blocks are quite uniform, having a standard deviation of approximately 0.015 inch. (auth)

SPECTROSCOPY

3927

Los Alamos Scientific Lab.
ELECTRON DENSITY FROM STARK BROADENED

PROFILES. Harry Dreicer. Sept. 1953. 19p. Contract W-7405-ENG-36. (LA-1631)

A theoretical analysis is made of the problem of electron density measurement in a discharge by the Stark broadening in spectral emission lines of H_2 and H-like ions. (K.S.)

3928

A SCINTILLATION SPECTROMETER. Björn Åström (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* **7**, No. 3, 241-5(1954). (In English)

The design and performance of a scintillation spectrometer using NaI(Tl) crystals are described. A method of improving the overload characteristics of a linear amplifier and the circuit of a simple one-channel differential discriminator are given. (auth)

3929

CALIBRATION OF A SCINTILLATION SPECTROMETER FOR THE COMPARISON OF γ - AND X-RAY INTENSITIES. B. Åström, A. H. Wapstra, S. Thulin, and I. Bergström (Nobel Inst. of Physics, Stockholm, Sweden). *Arkiv Fysik* **7**, No. 3, 247-53(1954). (In English)

The efficiency of a NaI(Tl) scintillation spectrometer for detecting electromagnetic radiations of different energies is determined by absorption methods and by measuring isotopes with simple decay schemes and known internal conversion coefficients. (auth)

THEORETICAL PHYSICS

3930

ON THE SOLUTIONS AT LOCALIZED SINGULARITIES IN THE UNIFORM RECTILINEAR MOTION OF A PARTICLE OF SPIN \hbar . Gérard Petiau. *Compt. rend.* **238**, 1568-70 (1954) Apr. 12. (In French).

The solutions of localized singularities are derived in spherical symmetry for motion along trajectories for the wave equations of a particle of spin \hbar in uniform rectilinear motion. (tr-auth)

3931

APPLICATION OF THE RAYLEIGH-SCHRÖDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM. Eugene P. Wigner (Princeton Univ., New Jersey). *Phys. Rev.* **94**, 77-8(1954) Apr. 1.

The motion of a single electron in the electrostatic field of a nucleus is treated by the Rayleigh-Schrödinger perturbation method, the whole electrostatic potential being considered as the "perturbation." The contribution of the first approximation to the energy vanishes. The second approximation gives a finite ionization energy which is, however, incorrect numerically. The first approximation also vanishes for potentials $\sim r^{-n}$ with $0 < n < 3$ but the second approximation is finite only for $n = 1$; it vanishes for $n > 1$, and is infinite for $n < 1$. (auth)

3932

CONFIGURATION SPACE METHODS FOR THE CONSTRUCTION OF POTENTIALS. Abraham Klein (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **94**, 195-6(1954) Apr. 1.

Methods proposed recently by Lévy and by Brueckner and Watson for the construction of potentials in quantum field theory by superficially dissimilar techniques are rederived on a unified basis, that of the underlying equations in Fock space. It is supposed that certain amplitudes contained in the state vector are primary physical interest, and it is demonstrated that the two methods differ essentially only in the order of elimination of the remaining amplitudes. The interpretation and practical use of the methods is discussed in a formal way, with emphasis on problems of consistency which limit the utility of the techniques. Elementary examples are discussed in the appendixes. (auth)

3933

THE CLASSICAL EQUATIONS OF MOTION OF POINT PARTICLES IN NEUTRAL MESON FIELDS. Frederic R. Crownfield, Jr., and Peter Havas (Lehigh Univ., Bethlehem, Penna.). *Phys. Rev.* **94**, 471-7(1954) Apr. 15.

The special relativistic equations of motion of point particles interacting with neutral scalar or vector meson fields are redetermined by applying a method originally developed by Infeld and Wallace for the electromagnetic case, which is based on the linearized equations of general relativity. This method, which is free of ambiguity, leads to the equations obtained previously by several authors by the method originated by Dirac in electrodynamics but differs from some of the results of Majumdar and Apte, who used a simplified version of a Infeld-Wallace method, which did not have recourse to general relativity. (auth)

3934

MODIFIED PROPAGATORS IN FIELD THEORY (WITH APPLICATION TO THE ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON). G. Feldman (Univ. of Birmingham, England). *Proc. Roy. Soc. (London)* **A223**, 112-29(1954) Apr.

Many attempts have been made to improve upon the perturbation expansion in meson-field theories, one such attempt being the introduction of modified propagators S_F' and Δ_F' . It is shown in this paper that the introduction of these new propagators (or at least in the form that has been proposed) creates new infinities which cannot be removed by renormalization. These new infinities are due to new complex poles of the modified propagators. A tentative prescription is put forth to get over these new difficulties, but it is still intimately connected with the perturbation expansion. Unfortunately, the prescription does not give an unambiguous answer. A particular S_F' is used in the calculation of the anomalous magnetic moment of the nucleon. The results obtained are no better than those of other workers. However, there are many reasons why this may be the case. It is also shown that the subseries which arises in this case leads, at best, to an asymptotic expansion in the coupling constant. The nature of the singularity at zero coupling is found. (auth)

TRITIUM AND TRITIUM COMPOUNDS

3935

MEASUREMENT OF THE TRITIUM CONCENTRATION IN NATURAL WATERS BY A DIFFUSION CLOUD CHAMBER.

E. L. Fireman and D. Schwarzer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **94**, 385-8(1954) Apr. 15.

The radioactivity of T is easily recognized and visually counted in a H_2 -filled diffusion chamber. A 6-in.-diam. diffusion chamber, filled with 100 psi of H_2 obtained by completely converting 14 cc of water in a Mg furnace, is used to measure the T concentration in surface water of the Long Island Sound, in New Jersey well water, and in a number of rain and atmospheric moisture samples. These samples had T concentration (T/H ratios) that ranged from 10^{-15} to 3×10^{-18} . Some samples were measured directly, others required some electrolysis to give measurable T concentrations. No T could be detected in glacial water. (auth)

URANIUM AND URANIUM COMPOUNDS

3936

THE β -URANIUM STRUCTURE. J. Thewlis (Atomic Energy Establishment, Harwell, Berks, England) and H. Steeples (Coll. of Tech., Manchester, England). *Acta Cryst.* **7**, 323-8(1954) Apr.

The noncentrosymmetrical structure put forward by Tucker and the centrosymmetrical one proposed by Tucker and Senio are refined, using the x-ray powder intensities of Thewlis, by a method of trial. It is concluded that the noncentrosymmetrical structure is correct, with an agreement residual of 19% as against 32%, but that both the main and subsidiary layers of atoms in the structure are puckered. In this respect the proposed structure may be considered as a combination of the previous two. A feature of the structure is the binding together of neighboring main layers by short bonds, 2.53 Å in length, between certain atoms. This bonding, together with the pairing of neighboring atoms along the vertical chains which run through the structure, suggests a tendency towards the formation of U_2 molecules. A similar tendency is noted in α neptunium. Atoms appear to be present in the structure in four different electronic states, with valencies of 3, 4, 5, and 6, respectively. These are the valencies exhibited by uranium in its compounds. Analysis of the structure, based on this valency allocation, shows that the short interlayer bonds are intermediate in character between double and triple bonds, and that the short bonds along the chains are intermediate in character between single and double bonds. (auth)

NOTICE

It has been necessary to omit the author index usually included in this issue. A cumulated author index for Vol. 8, Nos. 1-12A will appear in No. 12B, dated June 30, 1954.

